APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

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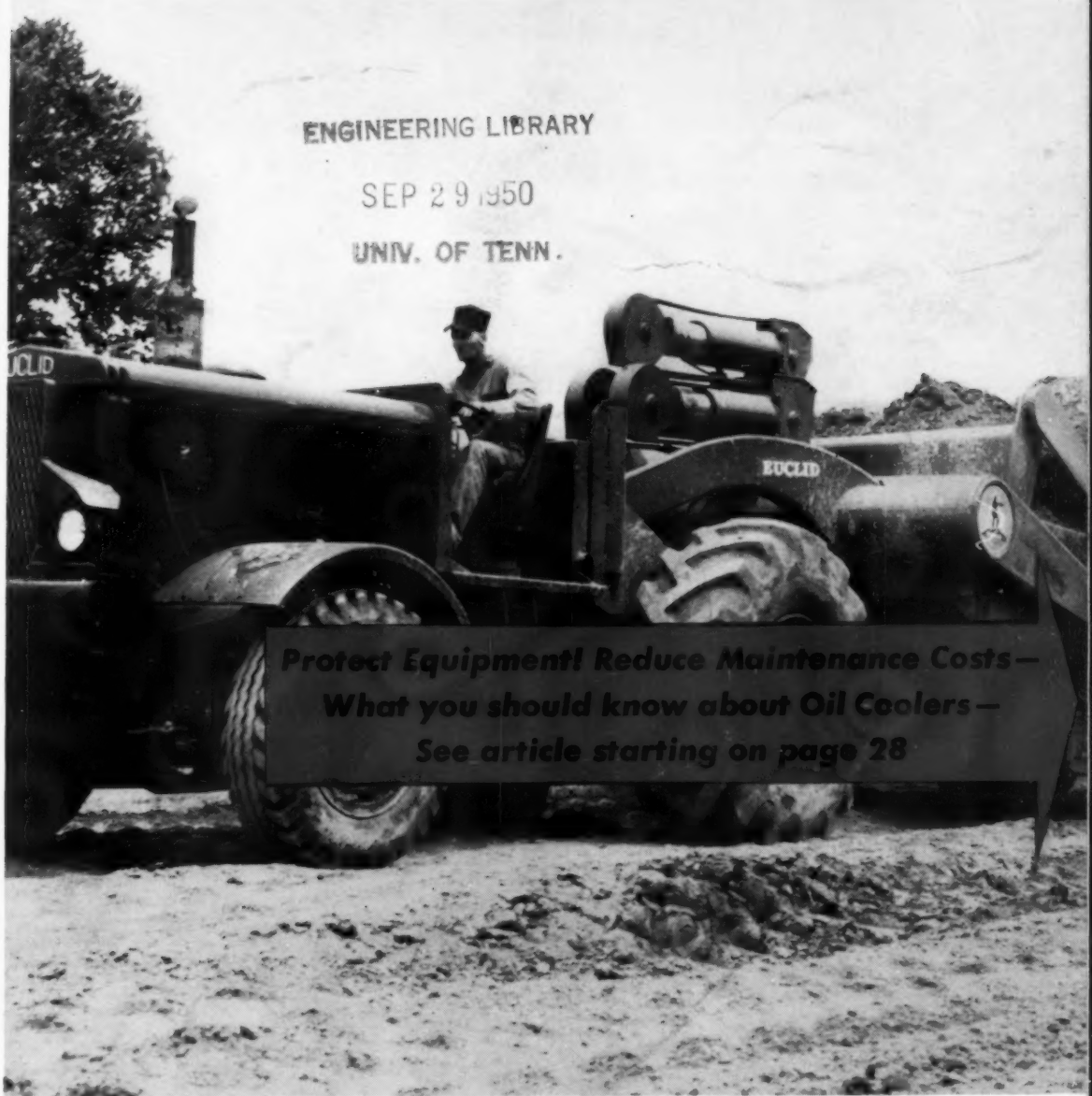

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...TEMBER, 1950

- HYDRAULIC CIRCUITS
- HYDRAULIC CONTROLS
- ...IR CIRCUITS
- ...IR CONTROLS
- ELECTRICAL AND ELECTRONIC CONTROLS

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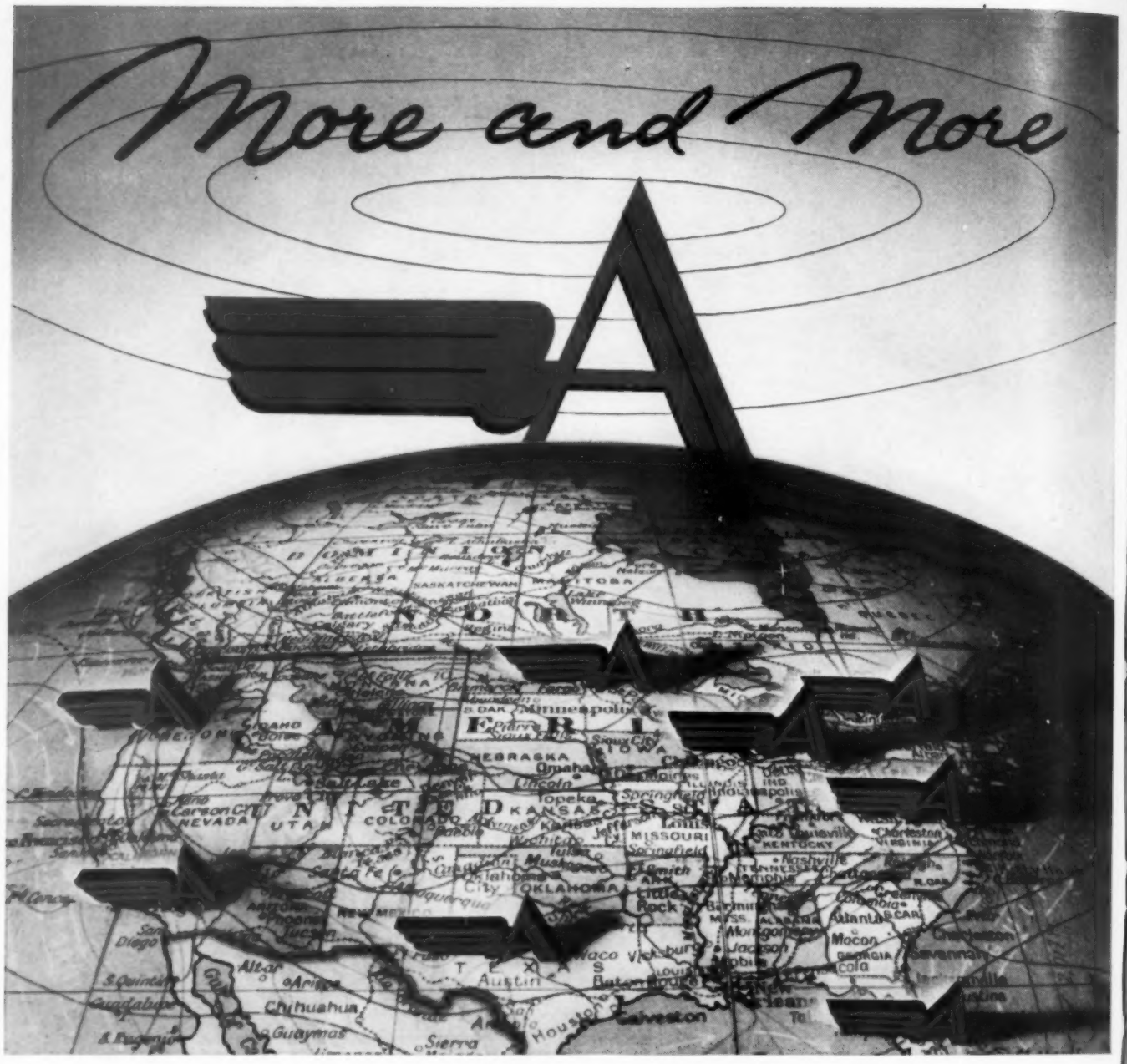

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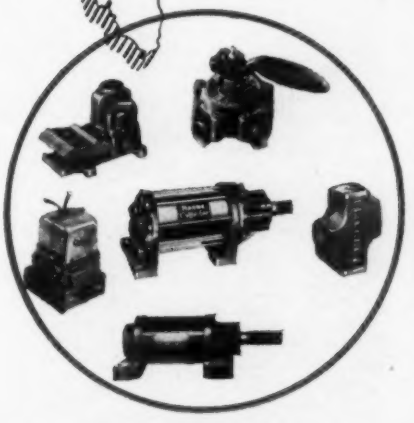

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FRONT COVER: Hydraulically actuated scraper doing roadwork on route 422 east of New Castle, Pennsylvania.
Courtesy The Euclid Road Machinery Company

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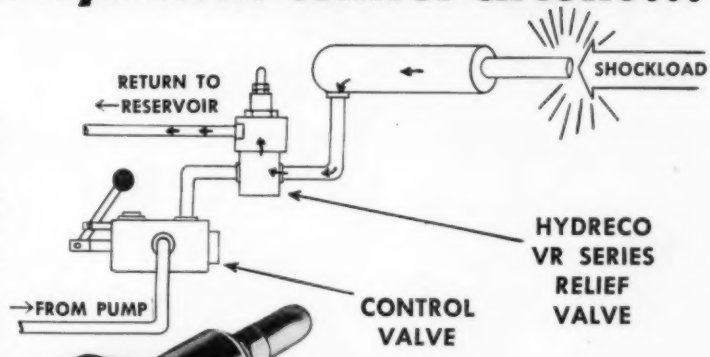

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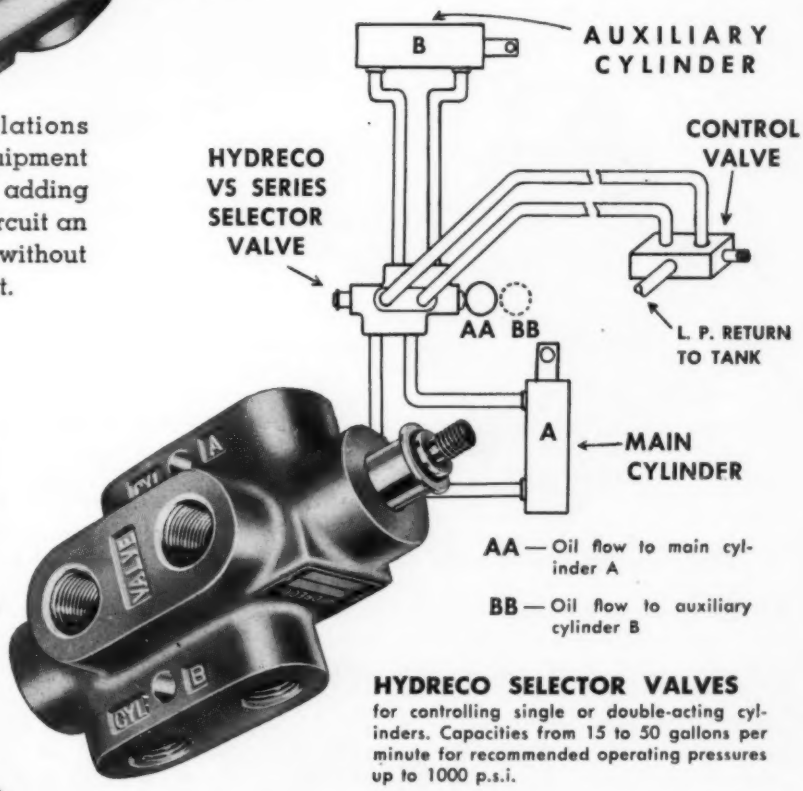

AA — Oil flow to main cylinder A

BB — Oil flow to auxiliary cylinder B

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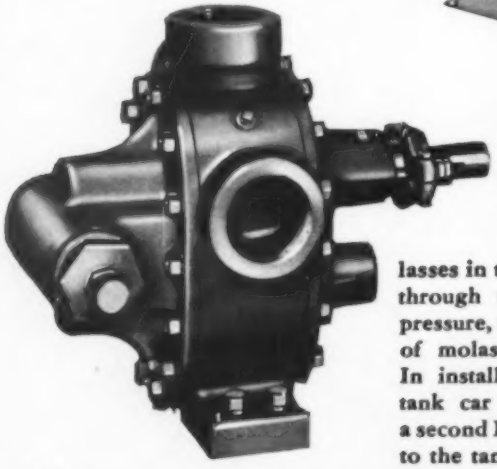
ROPER Rotary PUMPS

KEEP THICK, GOOEY MOLASSES MOVING IN...

WENGER FEED MIXERS

This unit, manufactured by Wenger Mixer Co., Sabetha, Kansas, is a compact, simply constructed mixer which blends thick, sticky, molasses with ground feed or hay. The tank holds 5100 lbs. of molasses. Capacity of mixer, 8,000 to 12,000 lbs. per hour, based on a mixture of 25% to 50% molasses.



A Roper 3600 Series Rotary Pump installed as standard equipment by Wenger is completely submerged in thick molasses when the mixer tank is full. Every 12 minutes molasses in the tank is completely circulated through this pump and by-pass under pressure, thus breaking down consistency of molasses to assure a better blend. In installations where a large tank or tank car is used for molasses storage, a second Roper serves to transfer molasses to the tank of the mixer.

This pump application is but one of many unusual installations : : . another tough job licked by Roper. Before you select a pump for either new installations or for replacement, investigate the Roper 3600 Series. Pressures to 60 p.s.i. — 40 to 200 g.p.m. sizes.

Write for complete information

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GEO. D. ROPER CORP.
709 Blackhawk Park Ave.
ROCKFORD, ILLINOIS

ROPER Rotary Pumps

Circle 10 on Reader Service Card

LETTERS to the Editor

Where can we send one of our young engineers that we want to develop into an instrumentation specialist? We have been told that there are short courses given in several plants but cannot pin down specific information.

J. P.

There are several manufacturers of instruments that maintain various types of training courses at their factory locations. Since we will run such a list in our October issues as a special feature, we will send you an advance proof of the list.

Do you have any more copies of the Data List? The one copy we had was "borrowed" and we would like to have two copies, if they are still available.

P.T.

Copies of the APPLIED HYDRAULICS *Data List are still available and we are pleased to send two copies to you.*

Just what is the difference between an operator and an attendant on a production machine? We have heard the term "attendant" several times applied to a person that operates an automatic production machine.

The distinction between the terms "operator" and "attendant" is being made more and more often by manufacturers and suppliers of special production equipment. The key difference is that an operator is one whose services require or involve a function of essential procedure, a skill that is based on training or judgment based on skill, while an attendant is one who merely starts and stops, loads and unloads or watches automatic operations. While there are, of course, borderline cases, the distinction seems a sound one for the operation of many types of automatic production machines.

Last year I wanted to attend the National Conference on Industrial Hydraulics and I was unable to secure a copy of the program in time to sell my department head on the importance of my (or some one else) attending. Will you publish or can I get a copy of the program earlier this year? I would appreciate this very much.

F.H.

The tentative program of the NCIH has been announced and we are carrying a brief story on it elsewhere in this issue. We hope to publish the full program in our October issue. However, as soon as the complete program is received we will send a copy on to you. We hope you get it in time to be able to go.

WHY ENGINEERS SPECIFY HOUGHTON'S "O" RINGS

Design engineers who continually specify Houghton "O" Rings base their preference on these points: **REASON 1** They can rely on high standards of quality and uniformity, regardless of sizes or quantities needed. **REASON 2** From past experience, engineers realize the dependable sealing and long-range performance factors which mean trouble-free service. **REASON 3** Houghton synthetic rubber "O" Rings, as well as the entire line of Houghton standardized packings, are backed by years of experience and "know-how" plus an engineering service always ready to cooperate on difficult design problems.

If you have a pneumatic or hydraulic packing problem, write or call E. F. HOUGHTON & CO., 303 W. Lehigh Ave., Philadelphia 33, Pa. **HOUGHTON'S VIM LEATHER & VIX-SYN PACKINGS**

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GREER ACCUMULATOR ON HARNISCHFEGER EXCAVATOR

Helps to Prevent Accidents
Avoids Costly Shut-downs
Serves as a Stand-by in Case of Power Failure

Photo courtesy of:
Harnischfeger Corporation,
Milwaukee, Wisc.

Mr. Germershausen of the Harnischfeger Corp. reports:

"We incorporated a Greer Accumulator in the original design of our P & H 1055 Electric Excavator to enable us to use a small and efficient power pack.

"The use of the accumulator enhances the safe operation of the unit by storing fluid pressure which in case of power failure automatically sets all brakes (hoist, swing and propel) to avoid dropping of the dipper, prevent swinging of the revolving upper, and eliminate runaways of the machine on steep slopes. Thus, the accumulator helps to prevent accidents which might result in injury to personnel, damage to equipment and costly shut-downs."

This is but one of numerous applications where Greer Accumulators are reducing operating cost and improving safety and efficiency of equipment and machines.

We at Greer are eager to discuss your particular hydraulic power requirements. Our Bulletin 300 describes in detail the construction and uses of Greer Accumulators. Write for your copy on your company letterhead.

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LITERATURE AND SERVICES OFFERED IN THIS MONTH'S ADS

AMERICAN CRUCIBLE PRODUCTS CO. Literature describing parts made from Promet bronze can be had. Estimates will be made from blue prints and operating data.
Circle 25 on Reader Service Card

THE COMMERCIAL SHEARING AND STAMPING CO. A 52 page catalog describing Commercial's hydraulic cylinders is now ready for distribution.
Circle 15 on Reader Service Card

THE CUSHMAN CHUCK CO. Current bulletins on Cushman air body power chucks and air cylinders are offered along with recommendations to meet individual tooling and production needs.
Circle 45 on Reader Service Card

DENISON ENGINEERING CO. Full details can be had on the Denison compensator controlled hydraulic pumps which allow unlimited adjustment of control for varying requirements.
Circle 13 on Reader Service Card

GREER HYDRAULICS INC. Bulletin 300 describing in detail the construction and uses of Greer accumulators is offered.
Circle 12 on Reader Service Card

THE HANSEN MANUFACTURING CO. Catalog giving descriptions and sizes of the complete Hansen line of straight through and shut-off coupling, for hydraulic and pneumatic connections is available.
Circle 3 on Reader Service Card

HONAN-CRANE CORPORATION. Full information can be obtained on purification and maintenance of hydraulic oils.
Circle 35 on Reader Service Card

KENYON INSTRUMENT CO., INC. A complete engineering data folder illustrates the 3000 psi shuttle valve designed to permit side loads on the shuttle to transmit directly to the body, leaving the pistons free to align themselves.
Circle 44 on Reader Service Card

THE PARKER APPLIANCE COMPANY. Tube fittings catalog 203 describing the complete line of fittings including Parker Triple-Lok can be had.
Circle 16 on Reader Service Card

ORTMAN-MILLER MACHINE CO. Details and specifications on the full line of cylinders in 1½ to 8 inch bores are offered.
Circle 22 on Reader Service Card

(Continued on page 43)

20 YEARS OLD

THE fact that our company is 20 years old this month is relatively unimportant to anyone except ourselves. Thousands upon thousands of other companies have become 20 years old, and much older. But, to us, the important thing is the way in which this company started, and the way it has progressed these 20 years. Because only in America could this story have been written.

This company started on the ashes of a depression failure. Our first magazine, INDUSTRY AND WELDING, had 24 pages in each issue, of which 3, 4, 5 or 6 were advertising. At 3, 4, or 5 pages, we couldn't pay our printer, but with 6 we could just make it. Whether there were 3, 4, 5, or 6 pages of advertising at no time removed the personal necessity of eating, dressing, and traveling to get the 7th, 8th, and 9th page of advertising. Somehow, we muddled through. In America, you can do those things—with pride.

Many was the time when it looked as though we couldn't make it and always, when it looked blackest, some miracle would happen and we'd be in business—for another month at least. We stuck. Friends were good to us. People had faith in what we were doing. You find that Americans like to help other Americans who are trying to help themselves. It is the essence of our country, of free enterprise.

No government questioned our right to be in business. No bureau told us what to print or how it should be said. We were free to make whatever profit we could manage and reinvest it in our own business or in any other way we saw fit. That, too, is the American way.

We chose to start magazines in other fields.No one told us what fields to start in or whether we could go into them. As long as we were willing to work and take the beating that every new, small business must take, we were permitted to build our own business in our own way.

These 20 years have been gratifying ones. It has been fun building a business. There's been a lot of hard work, long hours, and various worries, but we're glad we're in the publishing business, because we feel that we have contributed something to industry and to the general welfare of our country. We shall continue to do so. But again we say, ONLY IN AMERICA COULD THIS STORY HAVE BEEN WRITTEN. It is one of our great heritages which, unfortunately, we take for granted, and it's one worth keeping and worth fighting for.

Irving B. Dexter Publisher.

Hydraulics *Can* Give High Speeds

MALLEABLE NUTS ARE COMpleted at the rate of 2500 per hour on a special purpose machine designed by Roy Hays & Associates, for the Wagner Malleable Products Co., Decatur, Illinois. Nine hydraulic cylinders control all moving parts on this machine which produces ¾ in standard pipe thread nuts for thin wall conduit piping.

This is a two-cycle operating machine, one for indexing and one for performing the entire operations of finishing the nut. The front view, Figure 1, shows the large index plates. Index plate one carries three stations. Six blanks are loaded by the operator in station 1. The index plate then moves one-third turn, placing the six nuts under the sizing punches at station 2. At station 3 the nuts are transferred to index plate two which has four working stations.

At station 2, in the second plate, the six nuts are bored, reamed, faced and chamfered. In station 3, the nuts are tapped by a six spindle lead screw tapping head. At station 4, the nuts are removed from the machine, dropping into the chute at the front of the unit.

The operator loads the empty station while all finishing operations are being performed simultaneously. The tools return to their respective rest positions and the plates again index one-third turn before the operations repeat.

The circuit diagram, Figure 3, illustrates the hydraulic design and the selection of components. While keeping in mind that all finishing operations are performed simultaneously, follow the circuit from the loading station in index plate one to the knock-out station in index plate two.

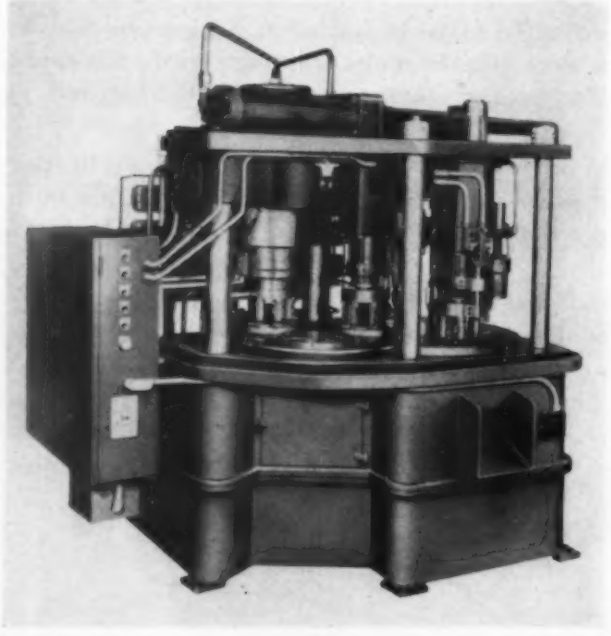
A 30 horsepower motor drives two double gear type pumps. Each of these double pumps house two separate gear type, fixed displacement units with built-in relief valves. The circuit diagram shows how the pumps supply each cylinder with pressure oil. The pumps are unloaded by the use of a solenoid operated, 4-way pilot valve (not shown in Figure 3) to vent the built-in relief valves.

Oil directed through the 4-way, single solenoid operated, open center valve (4) powers the 40 ton cylinder which moves the head carrying six sets of sizing and sprue trimming tools. The sizing blocks are equipped with trimming points and the punches are hardened so that the sprue is sheared off at the contact between punch and sizing die.

Note that limit switches at all nine cylinders are tripped by the stroke of the respective cylinder to actuate the solenoid operated valves.

Valve (9) in the sizing circuit is a counterbalance valve remotely controlled by part of the system pressure. This valve helps to prevent surging of the piston after the work is completed and the work

Fig. 1. Below: Front view of malleable nut machine.



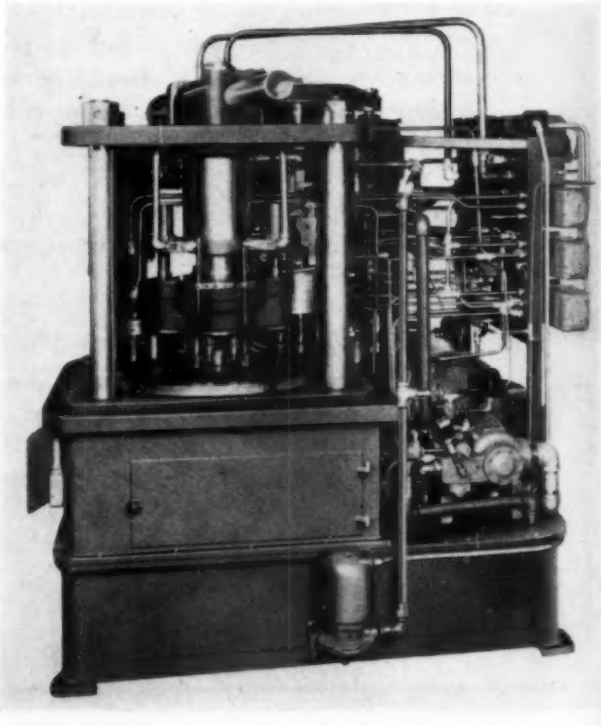


Fig. 2. Side view showing installation of hydraulic system.

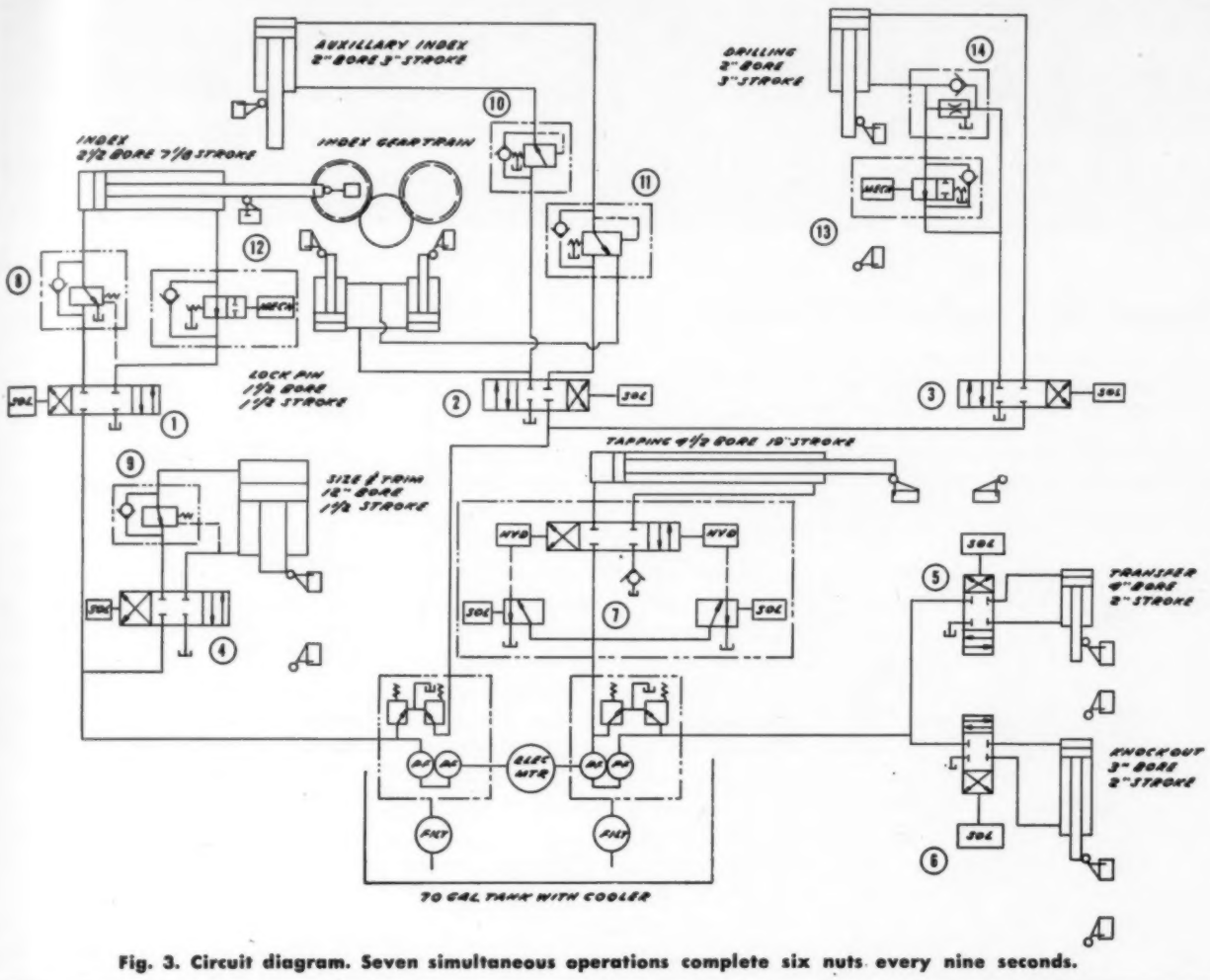


Fig. 3. Circuit diagram. Seven simultaneous operations complete six nuts every nine seconds.

resistance has decreased.

An 8 ton transfer cylinder pushes the nuts from station 3 of plate one into station 1 of plate two. The index plates overlap, that is, station 3 in plate one is directly over station 1 in plate two permitting the straight push through transfer without any complicated transfer linkage.

A flow control valve (14) is placed in the return line of the drilling circuit to control the speed and to help prevent the tools from jumping ahead when breaking through the work. Cam operated shut-off valve (13) is used in conjunction with the flow control valve. This is used to facilitate fast approach to the work and then give constant feed while performing boring, reaming, facing and chamfering of the nut.

During fast approach, return oil flows directly through the normally open valve (13) to the tank. When the piston moves down, the cam on valve (13) is actuated and the valve closes; oil is diverted through the flow control valve, and the correct drilling feed is established. To return the drilling piston, pressure oil is directed to the rod side through the check valve in the flow control unit.

A 19 in stroke cylinder performs the tapping operation. The nuts are pushed out of station 4 into the unloading chute by the six ton knockout cylinder.

The indexing cycle is performed by four hydraulic cylinders. Sequence valves (10) and (11) control the movement of the auxiliary and the lock pin cylinders. Pressure oil is directed through the check valve of sequence unit (11) to the head end of the auxiliary cylinder moving this cylinder forward to contact a roller pin connected to plate two. The pin acts as a positive indexing stop. When pressure builds up on the head end of the auxiliary cylinder, oil is diverted through valve (11) to the rod ends of the two lock pin cylinders moving them back to release the gear train.

Oil directed through the check valve of counterbalance (8) moves the main index cylinder forward to rotate the gear train, moving the plates the required one-third turn. Decelerating valve 12 which is normally open as the index cylinder moves rapidly forward, is partially closed by the action of a cam on the index plates to slow the indexing piston as the stroke is finished.

Now, oil through directional valve (2) enters the head ends of the lock pin cylinders moving them forward to lock the gear train in the new position. When pressure builds up in the head ends of the lock pin cylinders oil is diverted through the sequence valve (10) to return the auxiliary cylinder. The main cylinder then returns to its starting place and the production cycle repeats.

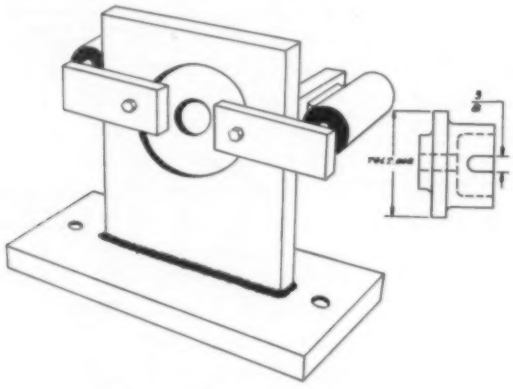
The design of this special purpose machine displays the convenience, versatility and high production made possible by hydraulic power. Seven production operations are performed simultaneously to complete six nuts approximately every nine seconds.

HERE'S HOW

- PREVENTIVE MAINTENANCE
- SERVICE PROCEDURES
- MODERNIZATION
- SHORT CUTS

Midget Air Cylinder For Clamping

MANY MILLING AND DRILLING JIGS CAN BE BUILT WITH air operated clamps rather than the usual hand-wrench locked, strap clamps. With air readily available in machine shops, using time and labor saving air clamps should be a first consideration of the jig designer and builder. Using midget clamps for light clamping jobs results in neat compact fixtures. A secondary machining operation on a cast aluminum brake drum called for milling a cutout, in the hub,

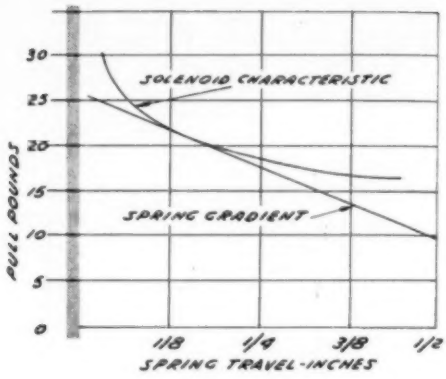


with a ⅜ in end mill. The o.d. of the flange being turned to within ±.002 presented a good locating surface for the milling operation. An angle type fixture was welded. A bore in the vertical plate located the drum. Keys in the bottom plate provide for quick set-up on the milling table. Originally two screw down clamps, one on each side of the drum flange, clamped the work. To speed up the clamping, midget air cylinders were suggested. Mounting blocks for the cylinders were welded to the sides of the fixture, rubber hose connections through a foot valve for on-off control were easily made. The original hold down screw and spring assembly was left to act as a fulcrum, making it unnecessary to provide hinge pins. Each midget cylinder applies a 75 pound force to the heel of the clamp. A 2:1 lever ratio in the clamp provides sufficient holding pressure. D. L.

Converting A Manual Valve To Solenoid Operation

WE HAD BUILT AN EXPERIMENTAL FIXTURE USING A manually controlled, spring offset, four-way valve. The unit worked satisfactorily and, before we knew it, the fixture was being used as a production unit.

To make the job more suitable for production, the manual controls could be made automatic by using limit switches to control a solenoid-operated valve. Rather than replace the entire directional valve, it was suggested that we remove the operating lever and mount a solenoid. At first, selecting the proper solenoid seemed like an easy order, but, although the procedure as outlined below is straightforward, some local digging and straining was required.



First we noted three requirements:

1. The pull or push of the solenoid would have to be greater than the spring reaction plus friction force plus an added factor to overcome sticking.
2. The stroke of the given valve was ½ in.
3. Fifty cycles per minute were desired. The solenoid would have to be energized approximately 50 percent of the time without overheating.

To determine the necessary pull, a spring weight scale, one of those tubular spring tension hand scales, was fastened to the valve spool rod. The force required to balance the valve spring as the spool was pushed in was measured. The value was about 25 pounds at full offset position. We plotted this spring gradient as shown, and then went to catalogs to find a solenoid which had a slightly higher gradient to provide a factor for overcoming friction and sticking.

The curves show our resulting choice. Manufacturer's data assured us that the solenoid would perform our job without overheating. From the start, we had assumed that it would be most practical to choose a direct-acting push type solenoid.

Since the solenoid had a 1½ in stroke and our application required ½ in motion without any linkage, the bar extension on the solenoid had to be modified and a cold rolled steel plate for mounting the solenoid was fastened to the valve body.

Converting the manually controlled valve to solenoid operation was quite successful and we believe the procedure we followed did avoid the difficulties and uncertainties which a trial and error selection usually creates. F. W. R.

Care Of Oil Lines

Keep lines straight as possible.

Choose lines of sufficient size to carry the oil without restriction.

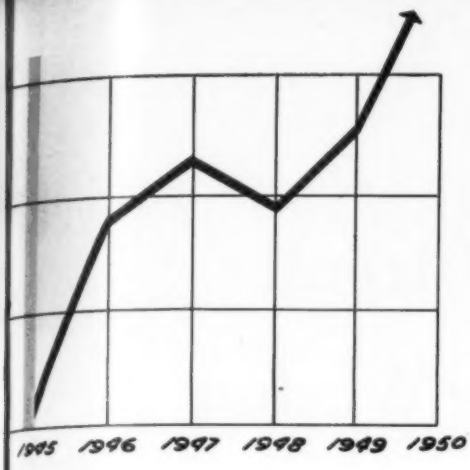
Keep lines short.

Make certain that shavings from pipe threads are removed before assembling line into valve.

When bending tubing, use generous radii.

From "THE FACTS OF LIFE"
Logansport Machine Co., Inc.

Readers are invited to contribute their short cost and labor saving shop or plant ideas. Each contribution will be acknowledged and considered for publication. We will pay $5.00 for each item published. —Here's How Editor



'50 Hydraulic Conference

THE TENTATIVE PROGRAM OF THE sixth annual National Conference on Industrial Hydraulics, which will be held Wednesday and Thursday, October 18 and 19, at the Sherman Hotel in Chicago, has been announced by Frank W. Edwards, conference secretary. A total of 20 papers are scheduled for delivery at four sessions. For the first time concurrent meetings will be held in order to complete the schedule in the two days and to permit selective attendance by those with special interests. As in former years, luncheon meetings and a dinner meeting will be held. Speakers for these meetings have not been announced to date.

Otto J. Maha, vice president, Hannifin Corporation, and conference director, believes that the 1950 conference will be one of the best balanced programs given in the history of the conference and arrangements, including the sectional meetings, are being made to take care of an increased attendance. Last year 357 persons were registered in addition to many men who sat in at one or more meetings without formal registration. The tendency, noted last year, of some companies to send groups of both design engineers and field sales and service men, is expected to continue.

As in previous years the National Conference on Industrial Hydraulics will be sponsored by the Armour Research Foundation of Illinois Institute of Technology and the Graduate School of the Institute, with the cooperation of seven technical societies: American Society of Civil Engineers, American Society of Mechanical Engineers, Society of Automotive Engineers, Western Society of Engineers, American Society of Lubricating Engineers, American Institute of Chemical Engineers and the Institute of Aeronautical Sciences.

In addition to a general session on Wednesday morning, when papers on hydraulic control problems in automatic transmissions and on operation and care of hydraulic machinery will be given, there will be sectional meetings on aeronautical, agricultural, refining and civil engineering hydraulics, centrifugal pumps, hydraulic presses, special fluid problems, hose and fittings and the control of surges. Such outstanding authorities as R. J. S. Pigott, director of engineering, Gulf Research and Development Company and past president SAE, who will speak on "Cavitation in Piston and Gear Type Pumps", and A. J. Stepanoff, development engineer, Ingersoll-Rand Company, who will speak on "Volute vs Diffusion Casing for Centrifugal Pumps", are on the two day program. Both Mr. Pigott and Dr. Stepanoff are internationally known in their fields. Dr. Stepanoff is the author of "Centrifugal and Axial Flow Pumps" and the recipient of the Melville Medal from the American Society of Mechanical Engineers and three first prizes from the Hydraulics Institute.

R. J. S. PIGOTT

The integrated plan of the 1950 conference permits more detailed subject coverages, e.g., the session on agricultural hydraulics will hear J. F. Ziskal of International Harvester Co. on "Utility of Hydraulic Power in Farming with Wheel-Type Tractors" and F. P. Hanson of Caterpillar Tractor Company on "Utility of Hydraulic Power in Farming with Track-Laying Type Tractors"; the session on hose and fittings will hear Don Stranberg of Anchor Coupling Company, Inc., on "Hose Assemblies and Related Fittings" and J. H. Swartz of Linear, Incorporated, on "'O' and 'V' Rings"; and in addition to Dr. Stepanoff's paper, A. E. Harnsberger of Pure Oil Company will give a paper on "Application of Centrifugal Pumps".

FRANK W. EDWARDS

Brief resumes of content of NCIH papers will be published in the October issue with photographs of authors and biographical notes.

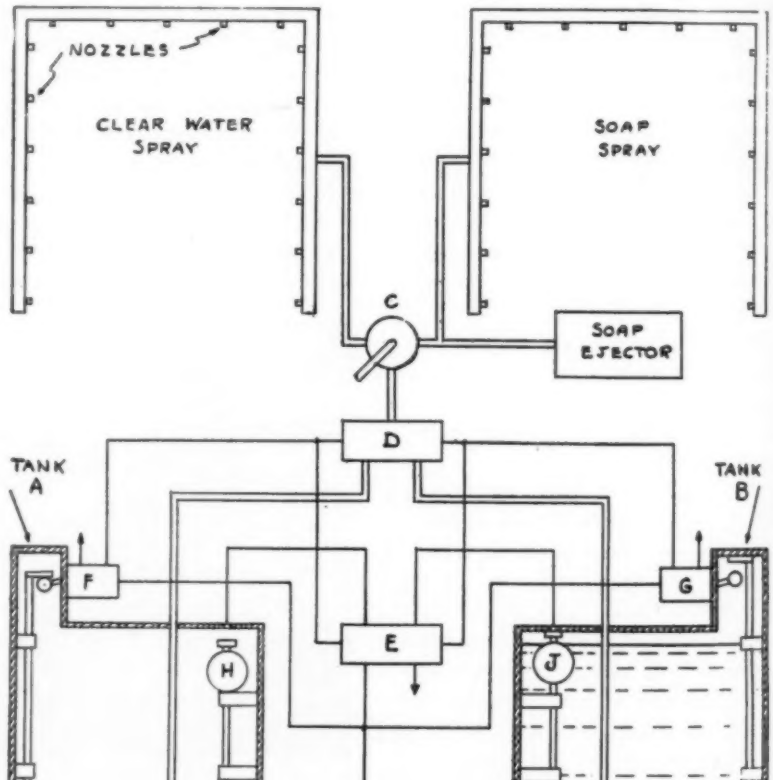
Air Circuit for Car Washer

By W. J. SCHUPNER
Design Engineer
Chicago, Illinois

ONE OF THE RECENT LABOR saving devices in the automotive service field which has proven a boon to service stations and garages is an automatic car washer. It is known as "Washmobile" and was developed by Service Metal Fabricators, Inc., Chicago, Illinois, after a long period of research. It is said that one attendant is able to wash five cars an hour and that considerable savings in soap and water result from its use as compared to ordinary methods.

The washing unit is in the form of an inverted U-shaped structure as seen in Figure 1, and is mounted on a track so that it may be rolled back and forth over the car during the washing period. Several units may be operated on an extended track at the same time. The movable frame is manually controlled and houses two banks of nozzles—one of which ejects clear water, and the other soapy water, depending upon the position of the operating valve. An important feature upon which the machine depends for its success is the relatively high constant nozzle pressure necessary—175 p.s.i., which is obtained from the service station air compressor in a manner described later.

There are five basic operations which must be performed during the wash cycle. First, clear water is sprayed over the car to wash away surface dust and dirt for about thirty seconds, This is followed by the forced ejection of soap suds or a detergent, in order to soak away road grime, for a period of twenty seconds. Next the attendant goes over the entire car with a soft, fluffy mitt or towel to remove all remaining dirt. This usually requires about three minutes for an average car. Then the dirt saturated soap suds are flushed away by another forceful spraying of clean water for a one-minute period, and finally the car is wiped dry with a chamois. Two high pressure water guns and two air guns on either side of the unit assist in cleaning the under carriage and wheels.



The circuit diagram in Figure 2

(Continued on page 42)

Needle Bearings in Pump Design

By B. T. VIRTUE and R. H. WHITE*

NEEDLE BEARINGS HAVE PROVED TO BE IDEALLY SUITED to gear pump applications. They carry high loads, maintain internal pump clearances and their small boundary dimensions permit the use of larger, stiffer shafts without decreasing seal surface to the point of lowering pump efficiency.

Figure 1, a typical gear pump, illustrates the large shaft diameter and short housing width which needle bearings make possible.

By using a larger diameter, shorter gear, with larger diameter shafts, less deflection and consequently less bearing distress will be encountered. It is also noteworthy that needle bearings, in permitting a larger shaft diameter, help maintain peripheral clearance, as well as good gear alignment.

The gears are straddle-mounted to further insure against the possibility of excessive shaft slopes. Designs have been encountered where the gears have been mounted on an overhanging shaft, producing a cantilever effect. Unless the pressures are extremely low, this construction is rarely satisfactory because of the probable large deflection of the shaft.

Note also the suggested use of drilled passages from the bearing bore ends to the intake galley to assist in the circulation of oil through the needle bearings and also to relieve pressure from the space immediately back of the input shaft seal.

The use of hardened gears reduces pick-up or scuffing between the gear end and the pump heads and thereby maintains low clearance and good hydraulic efficiency. The use of soft gears and grey iron pump heads has been found unsatisfactory when working pressures above 600 psi and pump speeds above 500 rpm are encountered.

Pumps driven with helical gears require some means of accepting thrust on the input shaft. In Figure 1 is shown a typical installation where straight spur gears or power take-off couplings were used to drive the pumps. Care has been taken to maintain good alignment between pump heads, body and pump gears in order to insure high pump efficiency. Clearances between the pump head and body are at a minimum without interference and the bearings are adequate to maintain clearances.

Hydraulic motors are more critical than pumps and therefore benefit more from the inherent advantages of needle bearings.

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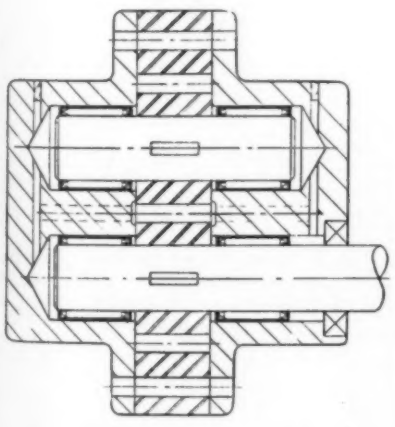


Fig. 1. The use of needle bearings make possible a rugged pump design. Lubrication channels help to relieve pressure behind the shaft seal.

H_R = vectorial sum of radial pressure forces
H_T = vectorial sum of tangential pressure forces
S = sealing force per gear
G_T = tangential force due to tooth load to drive driven gear
G_S = separating force due to tooth load to drive driven gear

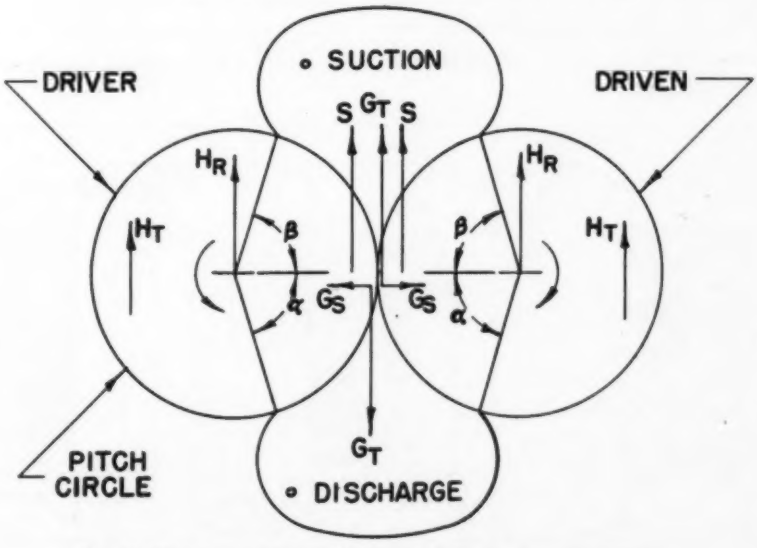


Fig. 2. Diagrammatic analysis of loads on a gear pump.

How To Choose THE PROPER PACKING

By H. C. MATHEIS

IN RECENT YEARS THE USE OF HYdraulically actuated equipment has increased many fold and with it has grown the need for a better understanding of packing installation and application. Some years ago a few thousand pounds pressure was considered a normal condition but today a hundred thousand pounds is being handled successfully and while forty to fifty thousand pounds per square inch pressure is considered high pressure, it is not unusual.

Temperature conditions are a limiting factor and very often dictate the type of material used. Development work is under way to handle temperatures up to 500 F.

There are five types of packings generally used today but only four are considered to be efficient. They are the "V" packing, "U" packing, cup packing and "O" ring packing. The fifth type is the flange packing and is very good for low pressures or for static oil and grease seals but is not considered very efficient as a seal for high pressures because it is difficult to maintain position.

The four most efficient types will be considered on the basis of their merits for different applications. No attempt will be made to give proportions or standard sizes since books giving this data are available.

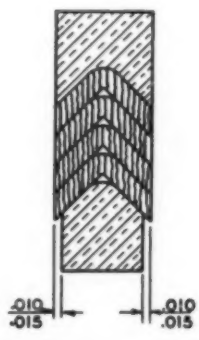
"V" Packings

The "V" packing has become popular in the last ten years because it is a packing which offers the greatest overall efficiency, wears, on the average, the longest and offers the greatest factor of safety.

The most important design feature for the proper application of "V" packings is the support rings, commonly known as male and female rings. Standard "V" packings are made on a 90 degree included angle, male and female rings must be made with the same angle in order that the packing will be properly supported. This applies to "V" packings either leather or synthetic homogeneous rubber. In the case of fabricated duck and rubber or asbestos and rubber "V" packings, the same holds true for the support rings. In cases of extreme pressure condition, the contour of the female ring may be altered slightly to better support the packing. The 90 degree included angle principle is the basic angle even though the contours have slight variations.

A typical "V" packing application is illustrated in Figure 1. It will be noted that care is exercised to have the radius in the bottom of the groove, in the female ring, the same as that in the packing. This is important because the packing under pressure follows the contour of the female ring. If the packing is distorted under pressure because the support rings are not of the proper contour, there will be premature failure of the packing installation.

To prevent extrusion, the female ring should be made with the clearances between it and the ram or cyl-



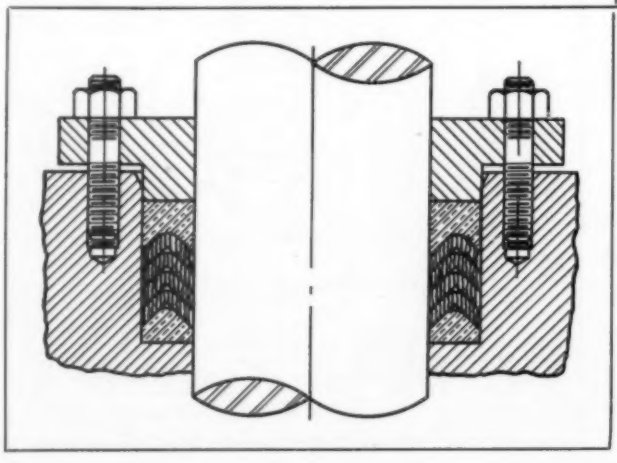


Fig. 2. Clearance on the male ring permits pressure to bypass and cause the packing to act mechanically, due to the fluid pressure.

Fig. 1. In this typical "V" packing installation care is taken to have the radius in the bottom of the groove, in the female ring, the same as that in the packing.

inder held to an absolute minimum. Contrary to this, the male ring should be made with a greater clearance so that pressure may bypass it and cause the packing, due to the fluid pressure, to act mechanically. Figure 2 shows a cross section of a typical "V" packing to illustrate the clearance on the male ring.

For high pressure applications, the "V" packing excels and should be given first consideration. The leather "V" packings will hold high pressures. Solid fabricated packing, with metal male and female rings, will hold pressures up to about 10,000 psi. The homogeneous "V" packing is satisfactory up to pressures of approximately 5000 psi when metal male and female rings are used.

The application of "V" packings is not restricted to the conventional gland as shown in Figure 1. When rotary motion is involved, "V" packing is very efficient, provided solid rings are used, because there is low friction loss. Solid rings must be used with leather and homogeneous "V" packings. If properly applied, split rings work out fairly well with the fabricated "V" packings.

"U" Packings

The "U" packing is believed to be the first shape ever to be used to hold pressure. Today, it is second only to the "V" packing in efficiency and long life.

As is the case with most hydraulic packings it is essential that the packing be properly supported. Do not support a "U" packing against the concave nose on a gland ring as pressure will often force the sharp edges of the gland ring into the shoulder of the "U" packing and cause failure. Figure 3 illustrates a "U" packing application where a metal pedestal ring is installed and a square shoulder has been machined on the gland ring. This pedestal ring prevents the packing from collapsing while not under pressure and holds the packing securely in position.

Clearance should be allowed between the inner walls of the "U" packing and the nose on the pedestal ring so that the natural swell of the packing will be compensated. The cross drilling of the pedestal ring is necessary to balance the pressure within the "U" packing and to give a uniform seal over the entire inner surface.

When using "U" packings, the pedestal ring is a recommended practice, particularly for materials where the thickness of the walls is relatively the same or where there is not a preload feature in the design of the packing.

An application of the homogeneous "U" packing is illustrated in Figure 4. It is possible to install the "U" packing without a pedestal ring when pressures are under 1000 psi. For higher pressures, 2000 psi max, when no pedestal ring is used, the "U" packing must be more firmly secured and 80 to 90 Durometer compounds used in place of the more commonly used 70 Durometer material. There are some designs of duck and rubber "U" packings, Figure 5, where pedestal rings are not necessary. There is a thick solid section of rubber at the base of the packing which results in a rigid construction precluding the need for a pedestal ring.

"U" packings, with the exception of the homogeneous packings, will hold the same high pressures as "V" packings, giving due consideration to the materials involved. "U" packings can be installed in the open gland similar to Figure 3 or on the end of the ram or piston. When installing them on the end of the ram, metal pedestal rings are mandatory because there is a differential in areas between the O.D. and I.D. walls. The area of the I.D. wall is less than the area of the O.D. wall and because the pressure acts equally in all directions, the resisting force created by friction is greater on the O.D. wall than the retaining force of the I.D. wall and

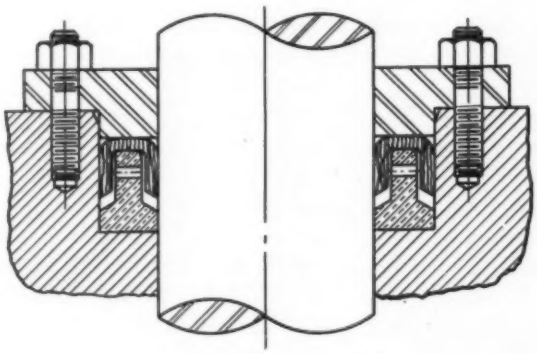


Fig. 3. A metal pedestal ring, used in this "U" packing application, prevents the packing from collapsing while not under pressure and holds the packing in position.

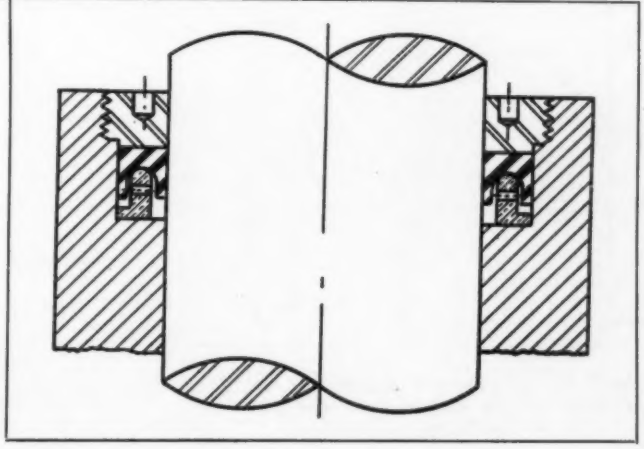


Fig. 4. This homogeneous "U" packing is supported on a pedestal ring. Cross drilling balances the pressure within the "U" packing to give a uniform seal over the entire inner surface.

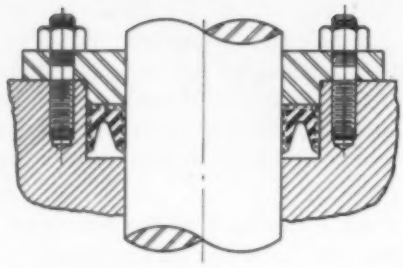


Fig. 5. Pedestal rings are not necessary with some designs of duck and rubber "U" packings.

the packing can pull out of its moorings if the pedestal ring, pressing down on the bottom, is not there to help retain position.

"U" packings are usually used for applications of reciprocating motion. They can be used for rotary motion

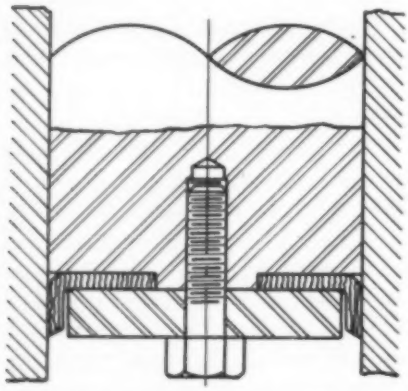


Fig. 6. The cup packing used only on the piston is a single acting unbalanced packing because it has only one sealing edge.

provided they are not subjected to a surface velocity of more than 1000 feet per minute. However, under these conditions they do set up greater friction than the "V" packings, particularly where leather is the material being used.

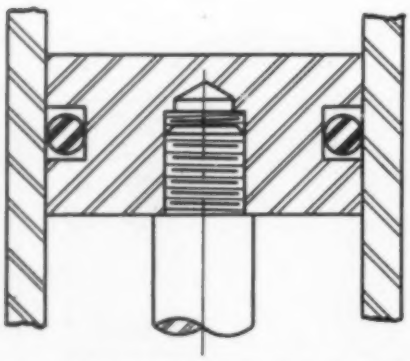


Fig. 7. An "O" ring will seal in both directions, one "O" ring will perform well on a double acting piston.

Cup Packings

The cup packing is known as a single acting unbalanced packing because it has only one lip or sealing edge, Figure 6. It is a packing to be used only on the piston or ram. It differs in its action from the balanced type of "U" packing or "V" packing in that it has only one wall on which the pressure can be effective. It, therefore, is a packing which must be carefully applied and maintained in position. A mechanical means of holding it in place must be provided in order that the resisting force on the lip will not cause it to become loosened or parted from the retaining follower plate. There is a shoulder on the piston to exert a definite compression on the bottom of the cup. The height of the shoulder is a function of "T", the packing thickness. For leather packings:

$$\text{Shoulder} = T - \frac{T - .010}{6}$$

For homogeneous and fabricated cups the shoulder should be 10% less than the thickness of the packing.

The shoulder secures the packing in position by giving a metal to metal contact between piston and inside follower plate. In many instances the face of the inside follower plate adjacent to the inside bottom of the cup is serrated with ridges, approximately 1/32 high, to bite into the packing material and prevent the cup from pulling away.

Pressure requirements restrict the use of cup packings. Leather cup packings will hold pressures up to 1500 psi. The same applies to fabricated duck or asbestos and rubber cups. Homogeneous rubber cup packings will withstand pressures of 500 pounds and less.

All materials from which cups are made are affected by the operating fluids. A clearance between the outer diameter of the follower plate and the inner wall of the cup, equal to approximately ⅓ of the thickness of the packing material, must be provided to allow for swelling.

Flange Packings

Flange packings should not be considered as a high pressure packing. It is fast becoming extinct as an efficient packing for high pressures. It is still used as a grease or oil retainer where very low pressures are involved. This evolution of the flange packing came about as pressures increased thus making it almost impossible to properly maintain the packing in position.

"O" Rings

The "O" ring packing and gasket is a relatively new type of packing. It was developed and used very widely and successfully during the last war. There is some hesitancy to use "O" rings because they seem to be a very delicate design, having very little volume in their cross section. "O" rings are very efficient, economical and long wearing, if properly applied. They can not be haphazardly installed, certain groove dimensions must be used. Surface finishes must be 16 micro inches max RMS for operating surfaces and 32 micro inches max RMS on groove surfaces. Clearances between moving parts must be consistent with operating conditions and at high pressures must be within a few thousandths of an inch as recommended in existing standards. Concentricities are important and must be in accordance with the standards.

"O" rings are used as a single unit up to pressures of 1500 psi. Beyond this pressure and up to about 3000 psi they should be installed with leather backup washers to prevent extrusion. Beyond 3000 psi, clearances should be held extremely close and backup washers, proper clearances, finishes and concentricities are mandatory. Many installations have been made at pressures of 5000 psi or more but lapped mating surfaces were required. The "O" ring is not merely a static seal packing. On the contrary, it is primarily a dynamic seal with static seal applications being a secondary feature.

As seen in Figure 7, a typical "O" ring application, the "O" ring will seal in both directions and one "O" ring will do a satisfactory job on a double acting piston.

Surface Finish

Surface finish requirements are not just confined to "O" ring applications. They are important in the operation of all types of packings, using any material. The life and efficient operation of any packing is

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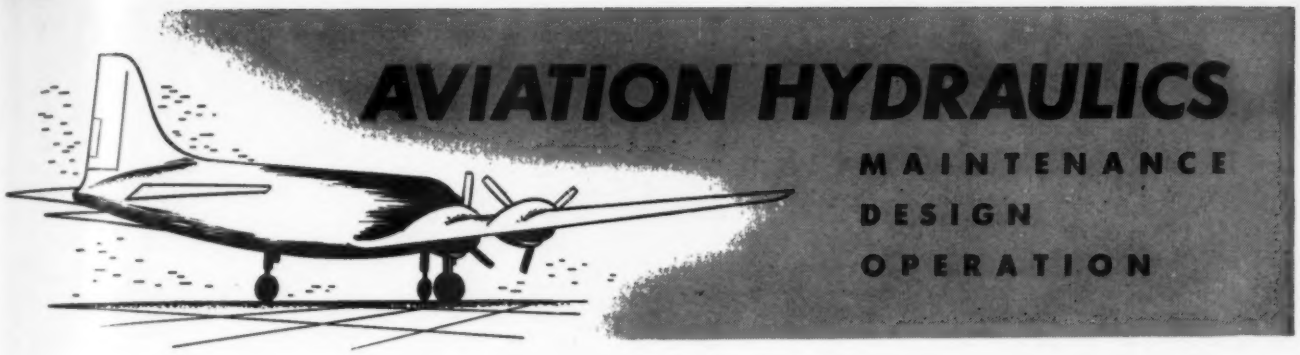


FRED O. HOSTERMAN
Advisory Editor

The Development of Anti-skid Braking

By GORDON W. YARBER
Research Engineer
Boeing Airplane Company

THE INCREASE IN AIRPLANE SIZE and landing speed to the point at which experienced pilots were unable to sense skidding and tires were often blown out attempting to obtain maximum braking, made it necessary to develop an automatic anti-skid braking system. When it is necessary to stop the airplane in the shortest possible distance, the problem of the locked wheel and resultant blown tire are critical. In an emergency, keeping the main wheel rotating and under control may save lives as well as tires.

The Boeing Airplane Company developed an automatic braking system as a solution to the problem of locked wheels and blow outs, a system which enables any pilot, regardless of braking skill, to make short landing rolls consistently without damaging the tires.

The program which took several years of development and testing, began without any preferred method of control, and had several additional requirements to the basic requirement of preventing skidding:

(1) Maximum braking must be approachable by the use of an anti-skid brake system;
(2) The amount of braking, to the point of causing skidding, must be under pilot control;

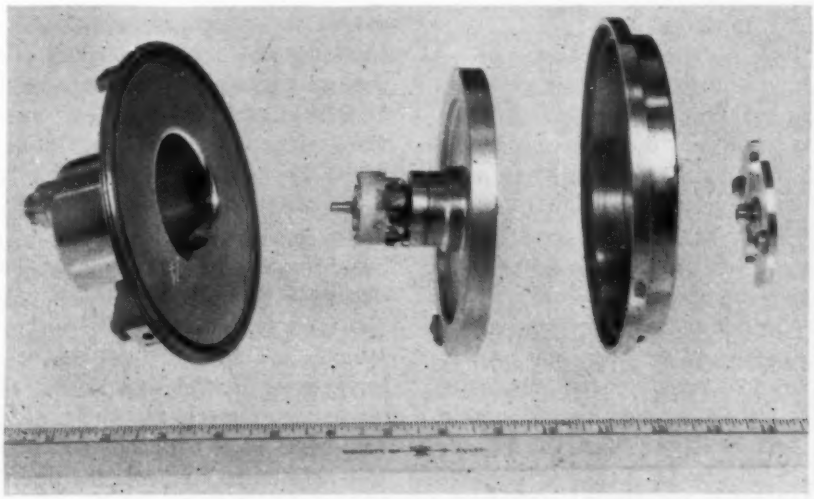


Fig. 1. Exploded view of skid detector components.

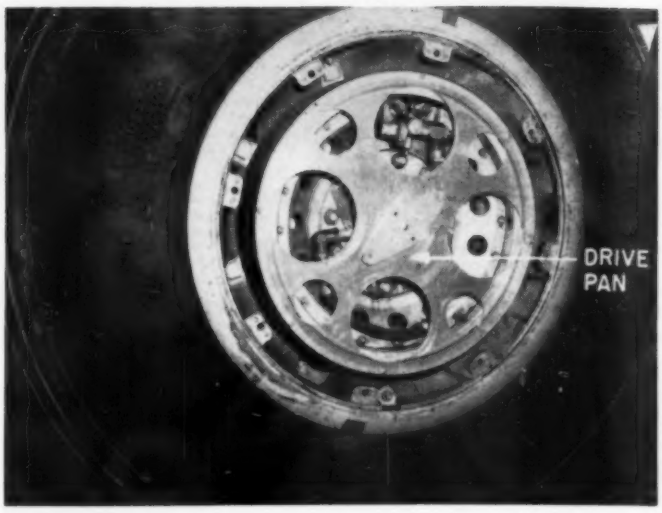


Fig. 2. Below shows skid detector assembled to an airplane wheel with the hub cover plate removed. The detector is located in the center of each of the main wheels and automatically sets the braking action to prevent skids. Right, the hub cover or drive pan engages by means of pins in a slotted driving link.

(3) Components of the system must be readily adaptable to any airplane, requiring only minor changes to the existing brake system;

(4) The control must be "fail safe" and never cause loss of braking due to malfunctioning, i.e., control failure shall return normal brake control to the pilot.

Two promising approaches to the problem of obtaining maximum non-skid braking became apparent. One was to prevent the start of skids by controlling brake pressure to a maximum value just under that causing the skid. The second, corrective in nature, was to employ a skid detecting device to cause release and reapplication of brake pressure as the braked wheel departs from and returns to non-skid speed. While the first method seemed more desirable, it was realized that the rapidly changing brake pressure required for maximum braking could not be automatically metered without causing occasional skids and that a skid control device would be required.

To accomplish the corrective type control, two noteworthy methods were considered. First, skid detection could be based on the differential speed between braked wheel and an equivalent freely rotating one. Voltage generators could be employed as a satisfactory means for obtaining skid signals. Second, skid detection could be obtained through angular deceleration of the braked wheel alone. For the latter, the flywheel inertia mechanism seemed practical.

To regulate the brake pressure below the skid point a pressure regulating valve and a damped mass was used to impart its deceleration force to meter maximum non-skid brake pressure. The flywheel inertia mechanism was chosen for skid detection because of its excellent control sensitivity, its simplicity and because its action is independent of any wheels other than the one to which it is attached.

A skid detector exercising remote control over a brake pressure releasing valve was chosen in preference to one with direct control because it was better adapted to brake systems using deboost valves and because it could best meet the "fail safe" requirements.

A test rig fabricated from two BT-13 landing gears pulled by a truck closely simulated airplane landing conditions. The tests proved that the principle of controlling brake pressure proportional to airplane deceleration required a brake lining with a more stable coefficient of friction than was commercially available. The automatic pressure regulating system was in error most of the time due to this friction instability; skid control was accomplished with the skid detector system as if it were acting independently. Further tests with the skid detector as the only control element proved it would provide a satisfactory basis for anti-skid automatic braking.

The skid detector, Figure 1, is in principle, a fairly simple mechanism that uses flywheel inertia to detect rate of change of wheel speed in excess of that encountered in maximum non-skid braking. The inertia force is used to close electrical contacts against a spring force that normally keeps the contacts open. Two pairs of electrical contacts are used, one to give a "skid" signal, the other to give a "recovery" signal, caused by flywheel deceleration and acceleration, respectively.

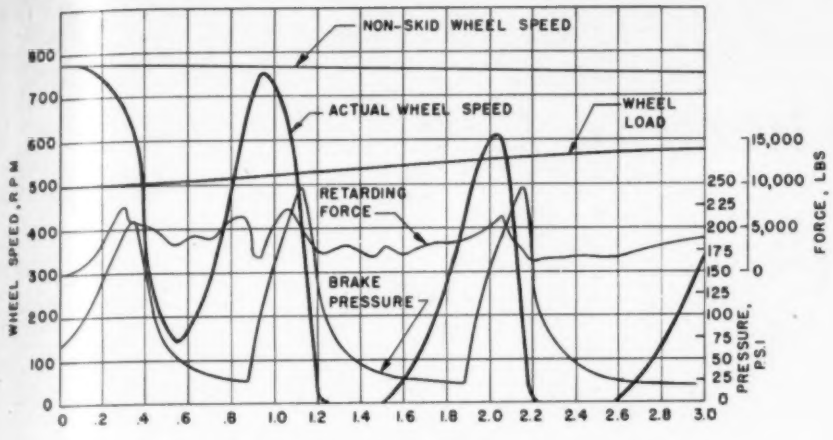


Fig. 3. Braking performance during severe skidding.

During normal skid control, an overrunning clutch allows the flywheel to maintain the skid signal contacts closed until the brake wheel has nearly recovered non-skid speed. As the wheel resumes full speed, the flywheel is accelerated through the overrunning clutch to close the recovery signal contacts. Since it is desirable for the flywheel to lose speed slowly and to recover it rapidly, the clutch delivers two different torque values, depending on the direction it is being driven.

Primarily, the associated electrical control system operates a solenoid valve to release brakes during the skid signal interval and reapplies them at the start of the recovery signal. To provide the control action required for adverse braking conditions (touchdown and icy runways), the function of the recovery signal is automatically changed from one of reapplying brakes to one of continuing their release until the flywheel has regained full speed.

The performance of anti-skid control with larger airplane wheels was investigated in tests at Wright Field using a 56 in high pressure tire, wheel and brake assembly with a complete anti-skid brake system mockup. Anti-skid brake control was performed during simulated landings in which the test wheel was "landed" on a 10 foot diameter flywheel rotating with a peripheral speed and proportional kinetic energy equal to that of a specific airplane at touchdown.

The ability to check the skids and to maintain effective retarding force with relatively small loss of wheel speed gave proof that the skid detector with its simple on-off control of brake pressure was a satisfactory solution in maintaining a rotating braked wheel while obtaining maximum braking.

The maximum retarding force was developed during the start of the skid while the wheel was within 100 rpm of non-skid speed. The retarding force or drag was actually greater with a slight amount of skidding than without. However, during severe skidding, a study of retarding forces, plotted in Figure 3, indicates that this increase in drag was limited to skidding with a small degree of slippage; that for wheel speed of 100 rpm or more under non-skid speed the retarding force diminished rapidly as the skidding became more severe and almost collapsed during the locked wheel condition. Due to nearly constant wheel load, the retarding force can be used as a direct indication of changes in runway coefficient of friction during various skid conditions. The maximum friction coefficient was developed while rotating with a small amount of slip or skidding. It was rather well established that the principle of metering pressure just short of that to cause skids to occur would not have allowed as fast stopping as did the skid correcting method.

The worst problem was encountered in actual flight test landings. Landings with brakes on at touchdown caused two blown tires before it was realized that a problem even existed. It appeared reasonable that a pilot would not start braking until he was certain all wheels were contacting the runway and rotating. However, flight test data and pilot experience proved this premise unsound and that anti-skid braking would be required to relieve the pilot of the responsibility of determining when the brakes could be applied.

It was difficult to determine just when to apply brakes since all braked wheels do not necessarily contact the runway immediately after the pilot feels the touchdown; actually, one or two wheels may "float" a fraction of an inch above the runway for several seconds after the apparent touchdown. While there is normally no need for braking during this critical period, the requirements of the emergency landing with minimum runway distance demand that the pilot be able to apply brake pressure anytime any one wheel is on the runway.

To allow the pilot to meter brake pressure before touchdown, the electrical control system was modified to hold the brakes released from each wheel independently until it contacts the runway and is accelerated to a high speed. The automatic skid control can be depended upon to take care of excessive brake pressures and keep the wheels rotating at close to non-skid speed while the airplane is brought to a fast stop.

Trouble Shooting In Test Flights

The flight tests were trouble seeking rather than efforts to establish short landing roll records. Brakes tested were well worn and in below average operating condition, yet an airplane weighing 112,000 pounds and touching down at 113 mph was stopped in 2160 feet with deceleration reaching a peak of 12.2 feet per second in the latter part of the roll.

In comparing stopping distances with and without anti-skid braking, there was a marked improvement in deceleration during the high speed portion of the landing roll. In the latter portion, as expected, there was no appreciable difference after skid control became infrequent. The most important achievement of anti-skid braking was the consistency in which the pilot could approach maximum braking without the hazard of blowing out tires.

How, When, Where to Use OIL COOLERS

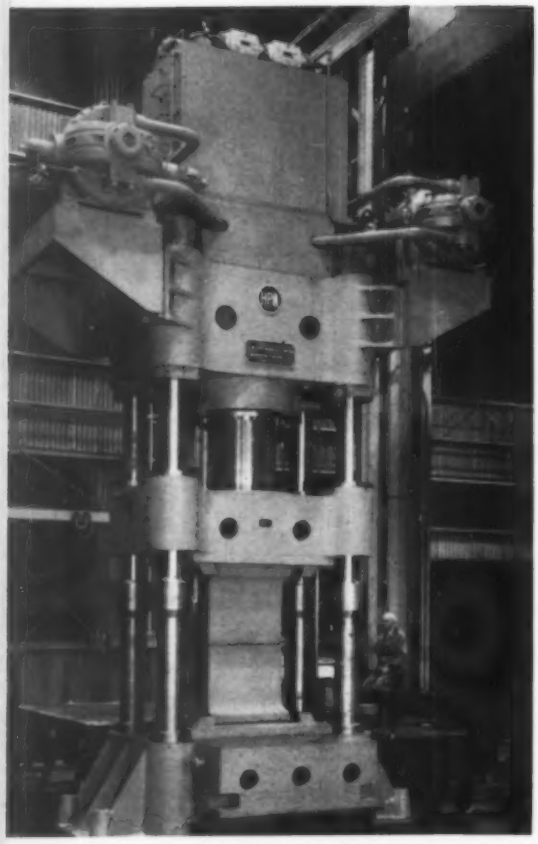


Fig. 1. Plate type oil coolers (top of press) on a 1000 HPM forging press. Fig. 7 shows an assembly of the cooler.

OIL COOLERS (OR HEAT EXchangers) are units designed to cool hot oil flowing through them by diffusion of heat through tubes or metal walls separating the oil from a colder medium, such as water, which also flows through the unit.

Oil coolers are used in a wide variety of types of machines to dissipate heat from hydraulic systems; the removal of heat being necessary or advantageous for the most efficient functioning and maximum production of such machines. Slippage, excessive wear due to inadequate lubrication, shutdowns which reduce machine output and packing deterioration can all result from excessive oil temperatures.

Oil coolers are necessary on industrial hydraulic systems, particularly on high pressure ones when the normal heat produced by movements of machine and hydraulic system components cannot be dissipated without an external cooling means. For low and many medium pressure services, such heat is dissipated by natural radiation by and through the pump or pumps, valves, cylinders, piping and the reservoir. Normal radiation, however, has a rather limited heat transfer coefficient—approximately 2 Btu per degree F per sq ft per hour.

On most high pressure hydraulic systems the amount of heat generated is appreciably above this quantity, with the result that the oil and the hydraulic system will run "hot" if not cooled. Since the manufacturers of pumps and, in some cases, valves and cylinders, recommend types or grades of oil that will give optimum performance at efficient operating temperatures, these grades should be used and working temperatures kept within recommended ranges. For example, a leading pump manufacturer recommends oils by their maximum viscosity range in SSU for average working temperature ranges. The top temperature permissible will be somewhat above the average operating temperature. A medium hydraulic oil for a range of 40 to 160 F will require oil with a viscosity range of 4000 to 70; this means that an optimum operating temperature of approximately 125 or 130 F, the viscosity will be approximately 100. Or, to cite another case, a leading press manufacturer rec-

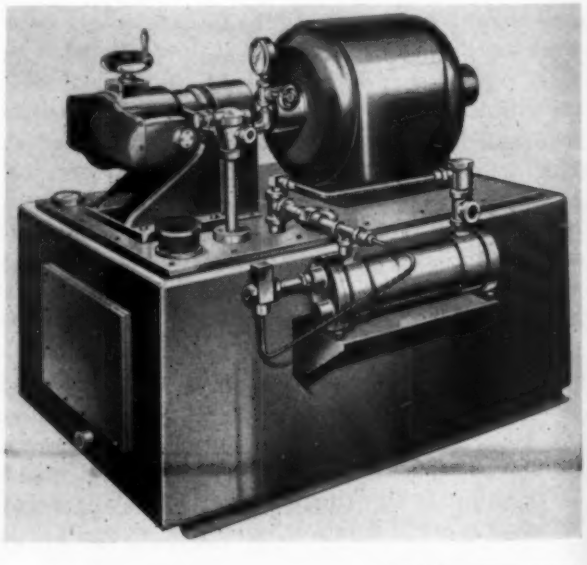
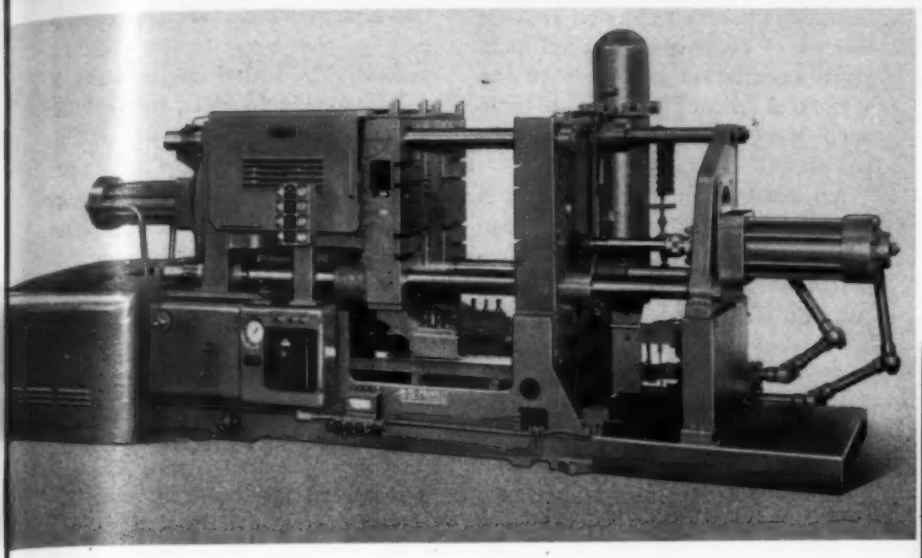


Fig. 2. Rear view of a Denison Engineering Co. high pressure pumping unit showing a standard two-pass oil cooler, operated by thermostatic control. Oil coolers are recommended when the unit is operated at 50 percent or more of maximum pressure or for 10 percent or more of total cycle time.



ommends 900 SSU oil and an operating temperature of 110 F. Figures 1, 2 and 3 show standard oil cooler installations on high pressure hydraulic systems.

There are two types of oil coolers in common use: (1) the multiple tube, also known as the shell and tube type; and (2) the plate type.

Tube Type Coolers

The multiple tube type of heat exchanger for cooling hydraulic oils is built in a number of standard sizes and pressure classes. Design pressure classifications for all diameters range from 75 psi to 600 psi, the lower pressure being in general use for this class of service. Tubes are mounted in a shell. Both single-pass flow and multi-pass flow types are used. Figure 4 shows the details of construction of a single-pass flow type.

Multi-pass flow types are frequently used where water rates are high, since, with a given quantity of cooling water, a higher velocity of flow is obtained, increasing the rate of heat transfer. This type is also advantageous where space is at a premium because both inlet and outlet water connections are at the same end.

Single-pass types are often used where it is practical and economical to pass relatively large quantities of cooling water through the tubes. With large size connections and ample flow areas, a high rate of water flow is passed with slight loss in pressure head.

Variation of this type are the tube-and-bundle (Figure 6) and the tube and fin coolers, the latter of which are air cooled. The tube and fin coolers, together with the plate type discussed later and a new variation of the latter in aluminum, the aluminum plate type oil to air cooler (Figure 8), are used for many aviation oil cooling requirements.

All tube type coolers are equipped with baffles which direct the flow of oil for maximum heat transfer. Cooling water passes through the tubes, oil to be cooled passes around the tubes, the baffle arrangement assuring maximum wiping of the tube surfaces. A standard baffling arrangement is illustrated in Figure 5. Bonnets or end covers of the shells are bolted to shell flanges for easy removal for inspection or tube cleaning.

Plate Type Coolers

Plate type coolers are also furnished in a number of standards sizes with a standard design pressure classification of 150 psi constant or 75 psi reciprocating.

The construction of the plate type cooler differs from the multiple tube type in three major respects: (1) the removable cooling element is composed of a series of plates instead of tubes; (2) the oil flows through the plates while the water is circulated through the casing and over the tubes; and (3) they are rectangular or square in shape instead of cylindrical. Figure 7 shows a cutaway assembly of this type of oil cooler.

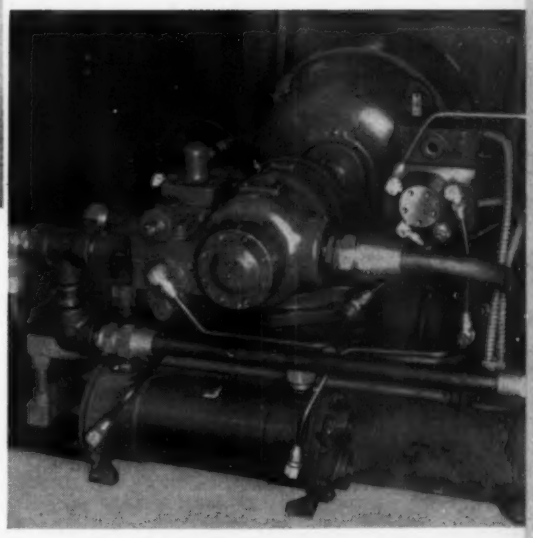


Fig. 3. A shell and tube type oil cooler is standard equipment on the Reed-Prentice die casting machine (above left).

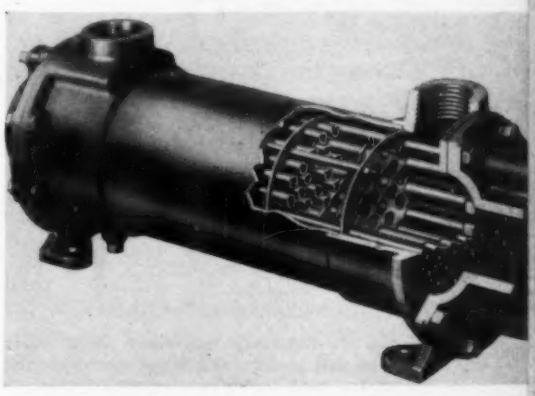


Fig. 4. Cutout view of a new type shell and tube oil cooler of single pass design.

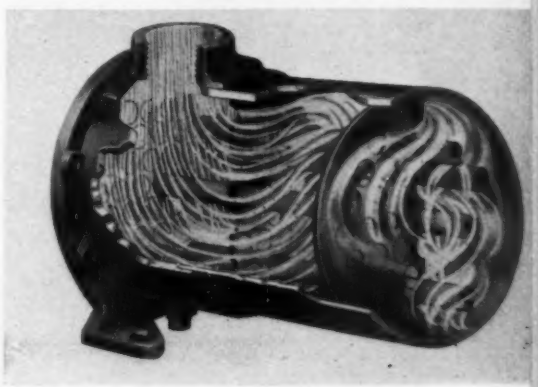


Fig. 5. Transverse baffling directs oil flow over tubes, the wiping action assuring the most efficient heat transfer.

Each plate in this type is a subassembly of an upper and lower stamping of copper nickel alloy and a central steel (or copper nickel) distributor strip. This strip creates turbulence in the oil stream, increasing the cooling efficiency, provides indirect cooling surface to increase the heat transfer ratio and reduces the size of the cooler required for a given installation and adds to the structural strength. These three parts, when brazed, form an individual plate.

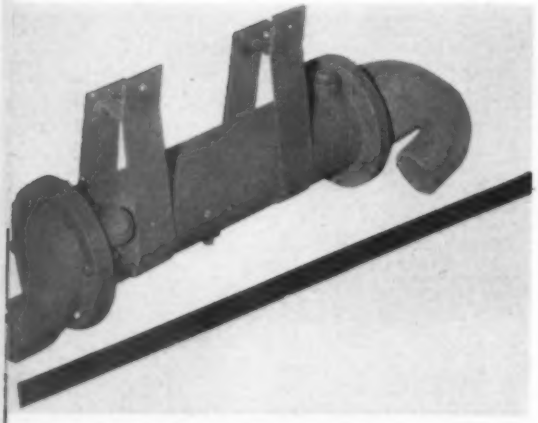


Fig. 6. A tube and bundle type heat exchanger for torque converter cooling on buses. The mounting bracket is special to a customer's specification.

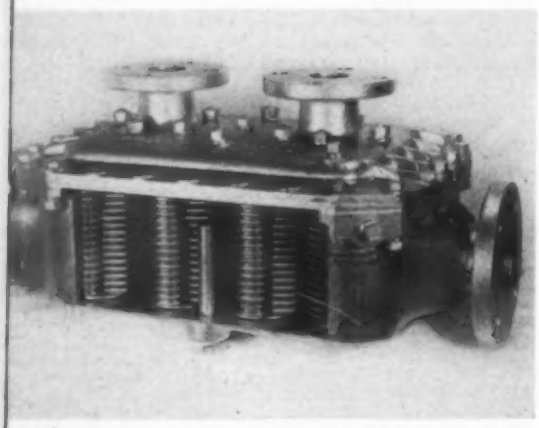


Fig. 7. Cutaway assembly of a plate type oil cooler. Oil flows through the plates and water is circulated through the casing and over the tubes.

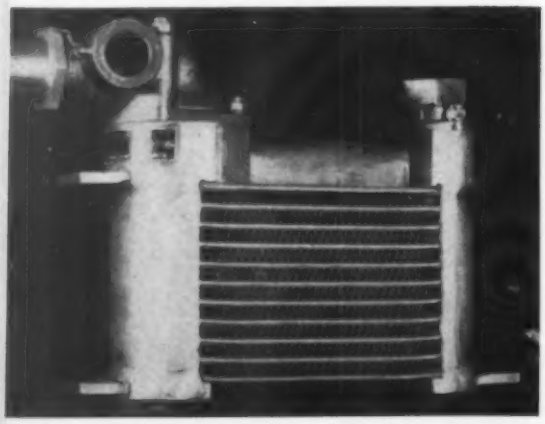


Fig. 8. An aluminum plate and air fin type of oil to air cooler used for aviation lubricating and hydraulic oils.

An assembly of plates, plus a header plate and stud assembly, copper brazed together, forms the removable cooling element or core of the unit. When assembled, the plates are spaced to permit cooling water to circulate freely over the exposed surfaces. The cooling element is inserted in a housing with water connections in it and a cover with oil connections is bolted to it.

Most machines and circuits that require oil coolers are furnished with this equipment. Nevertheless, there are a large number of industrial machines that definitely could be operated more efficiently and economically with an oil cooler. The decision is arrived at on the basis of economic factors. If the savings resulting from elimination of the difficulties mentioned above justify the cost of the oil cooler, plus installation costs, plus cooling water costs, then the installation is readily justified.

What Do You Need To Know To Select An Oil Cooler?

Five factors should be known in order to select an oil cooler:

(1) The maximum heat transfer required in Btu/min
(2) The volume of oil in gpm and the grade of oil handled
(3) The top temperature at which the oil is to be maintained
(4) The maximum temperature of the cooling water, and
(5) The psi pressure on the oil side.

In some cases, depending on the position of the cooler in the system, the allowable oil pressure drop through the cooler is also a factor, particularly if the cooler is installed on the suction side of the pump.

Manufacturers' instructions take care of factor 3 and factor 4 is determined by the purchaser from his plant data. Factors 2 and 5 depend on the point in the system in which the cooler is to be installed. There are three position possibilities. First, the oil cooler may be located on the return line just ahead of the oil sump. Since the most efficient heat transfer is obtained at the point in the system where the oil temperature is the highest, this position would be indicated on the basis of the greatest differential between the incoming oil and cooling water. This assumes that the oil flow, which has an important bearing on the cooler size, is at a maximum at this point. At this point high pressures or high pressure surges are often present, necessitating the use of check valves to reduce the pressure. However, if the check valve fails or lags, the cooler may be damaged, resulting in downtime, loss of oil and replacement of valves and cooler.

Second, the cooler may be installed on the suction side of the pump. In this case it must be determined that the pressure drop is low enough to avoid pump slippage which can result in heat input to the system or in reduced overall efficiency of the system due to reduced pump flow. The latter, in severe cases, may make the system inoperative.

Third, a logical compromise of factors seems to be in the use of a separate cooling system attached to the oil sump. The oil is drawn from the sump, put through the oil cooler and returned to the sump. This arrangement permits the selection of a constant oil flow to obtain the greatest efficiency from the cooler. This system also eliminates the possibility of high pressure damage to the oil cooler and permits minor repairs to be made without shutting down the machine. Several leading press manufacturers install oil coolers in this location.

Factor 1 is probably the most difficult to estimate. This information may be obtained in one of three ways: (1) from the hydraulic equipment manufacturer; (2) by considering a percentage of the total input power to the system as heat loss and converting it to Btu/min; or (3) by determining the temperature rise of the volume of liquid in the sump and system over a period of time and converting it to Btu/min. When the latter method is used it is essential that such a temperature rise cover the maximum work load and ambient conditions.*

(Continued on page 42)

* *Examples of problems and of solutions will be given in a separate article scheduled for later publication.*

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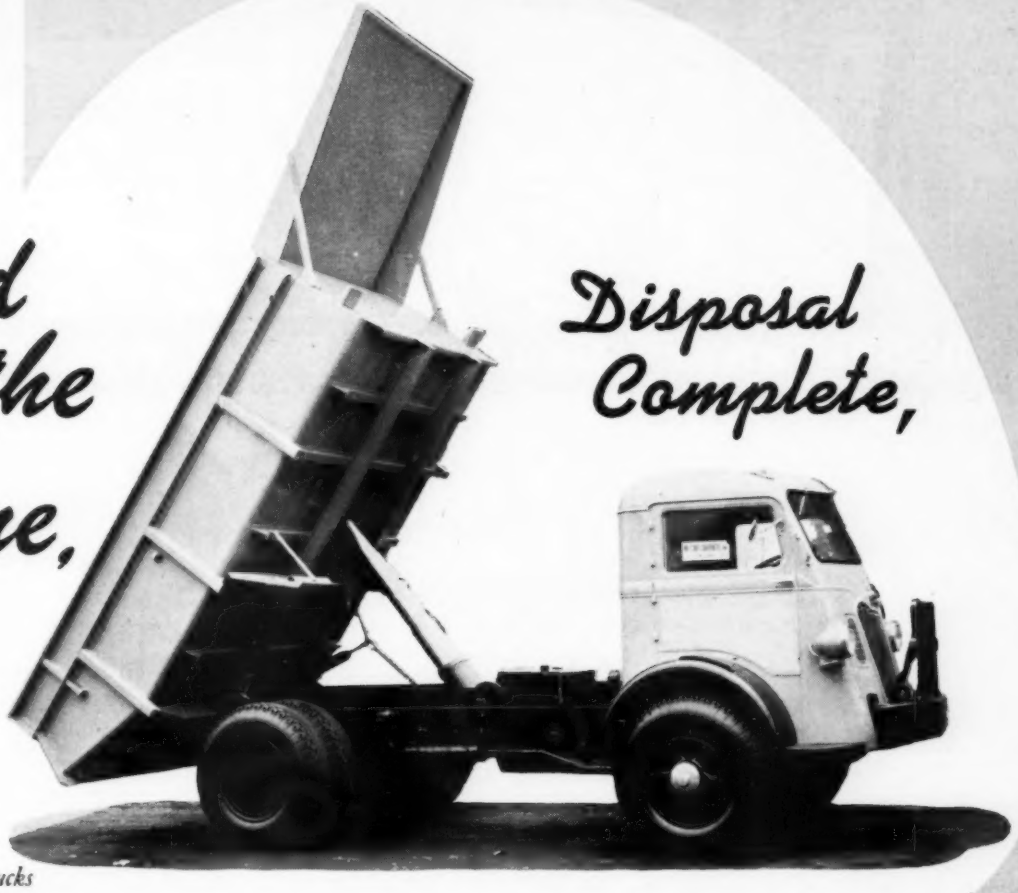

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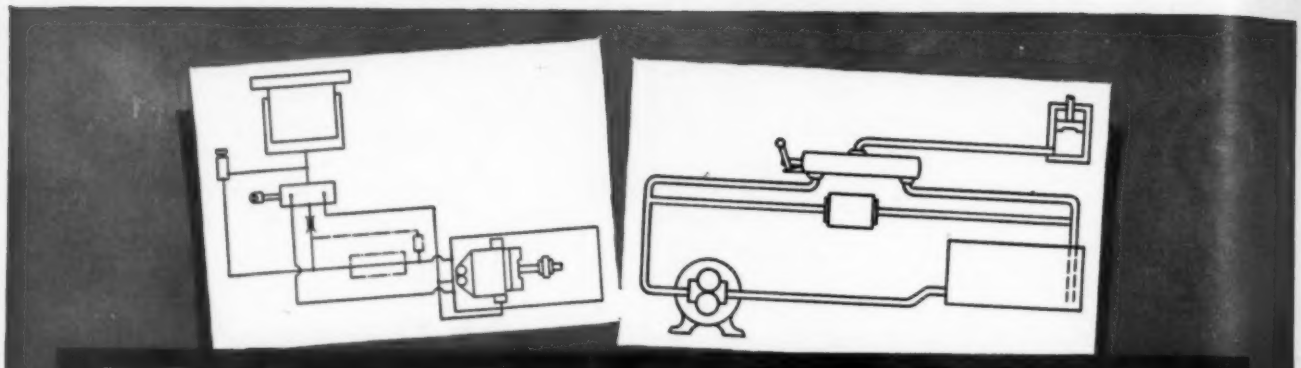


A Beginner's Course in Basic Hydraulics

CHAPTER VII

DIRECTIONAL VALVES

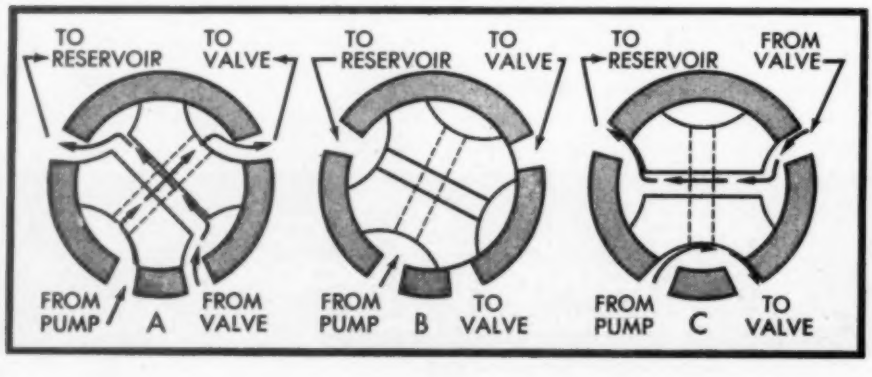
Part 3

Rotary, Metering, Time Delay and By-Pass Valves

ROTARY DIRECTIONAL VALVES ARE most frequently used as pilot valves for directional control valves. The direction of flow is controlled by a rotating core, which may contain one or two passages. One passage cores function as closed center valves, two passage cores function as open center valves as described below.

Figure 99 shows three positions in the operation of an open center rotary pilot valve. The left figure A is the feed position, the right figure C is the return position and the center figure B is the neutral position. In figure A, oil flows from the pump, through one passage in the core to one end of the four-way valve it controls, while oil from the opposite end of the same valve flows through the other passage to the tank. This flow causes the spool of the four-way valve to move, directing flow of the main circuit to operate the feed. When the core of the rotary valve is moved to the return position (C) flow from the four-way valve is reversed from the feed position. Pump flow is directed to the valve end which was open to drain in A and flow from the opposite valve end is opened to the tank. In this position one passage is blocked. In the neutral position, center figure B, both passages through the rotary core are blocked.

Some rotary valves are single passage or closed center types. These valves can be operated manually, mechanically, electrically or hydraulically.



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A schematic view of a rotary valve to control flow to a four-way spool valve is shown in Figure 100. Oil passes from the pump through the rotary valve on to the spool valve, where it positions the spool valve to direct flow from another pump to one side of a work piston. Through a return line, oil is conducted from the opposite end of the spool valve back to the rotary valve, through the second passage to the tank. In the return cycle, as we have seen, the flow from and to the spool valve is reversed.

Metering valve. A partially cutaway rotating core can be used to meter the flow of oil. A simple schematic arrangement of such

Fig. 99. Operation of a rotary pilot valve. A is the feed position; B neutral and C is the reversed or return position.

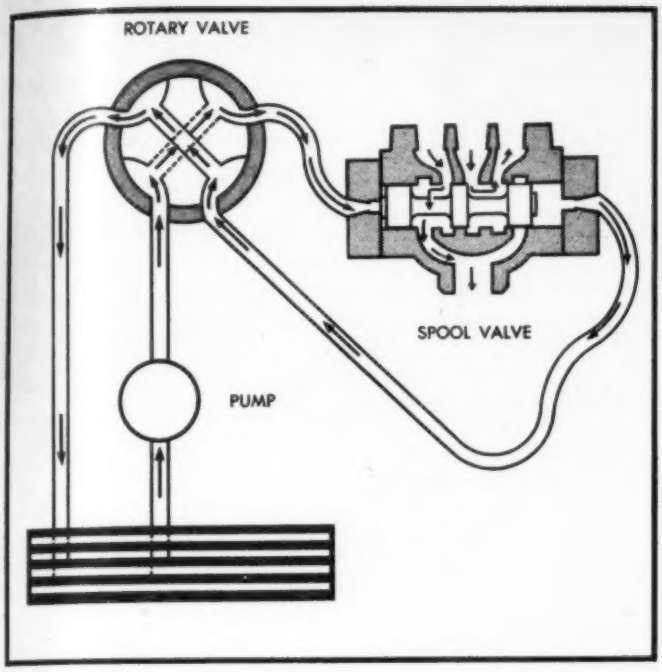


Fig. 100. Schematic view of a rotary valve used to control flow to a four-way spool valve. In this view the rotating core is in the feed position.

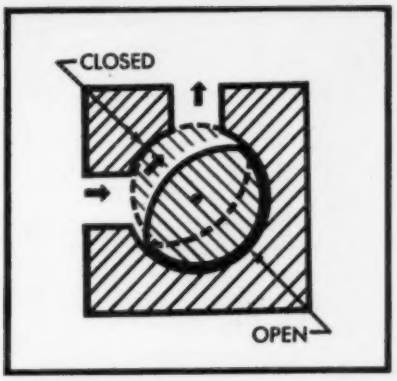


Fig. 101. A variable inlet resulting from the rotation of cutaway core is a common design used for a metering valve.

core is shown in Figure 101. As the position of the core is changed, a greater or smaller quantity of oil is allowed to pass through the valve. In this way the speed with which an operating part moves can be controlled, the action of the valve delayed or cylinders cushioned at the end of a work stroke.

The metering valve could be used to prevent a tool from breaking through too rapidly at the end of a work stroke or to decelerate a ram to a stop without damage or strain to the work or machine components. Such a valve, once set for a required feed, is normally locked in position for a tooling or work run.

Time delay valve. Figure 102 shows the schematic arrangement of this type of valve. It is used where a change of flow from one part of a cycle to another is to occur only after a definite time or interval. Oil from the pump through a control valve may take one of three paths: (1) around the time delay valve past check valve A to the work; (2) through the time delay valve; and (3) through check valve B to produce a force on the bottom of the piston in the time delay valve which is held in place by a spring. As an increase in pressure compresses the spring, the piston rises to shut off flow through the time delay valve. Figure 102 shows the valve in this position.

When the four-way valve is reversed for the next cycle, oil from the cylinder or work must return through the time delay valve. Passage 1 is blocked because of presence of check valve A. Passage at piston of time delay valve is closed until the piston moves downward. The rate of this downward movement is controlled by the setting of the needle valve. Oil will flow from chamber C through the needle valve to tank; the adjustment of this valve determining the time or delay between cycles.

By-pass valve. This type of valve is used for operations that have definite sequences, i.e., one operation or cylinder finishes its cycle

Fig. 102. A typical design of a time delay valve. The "delay" is accomplished by a setting of the needle valve, which exhausts oil from chamber C, permitting piston of the valve to move down and oil from work to flow through past needle valve to tank.

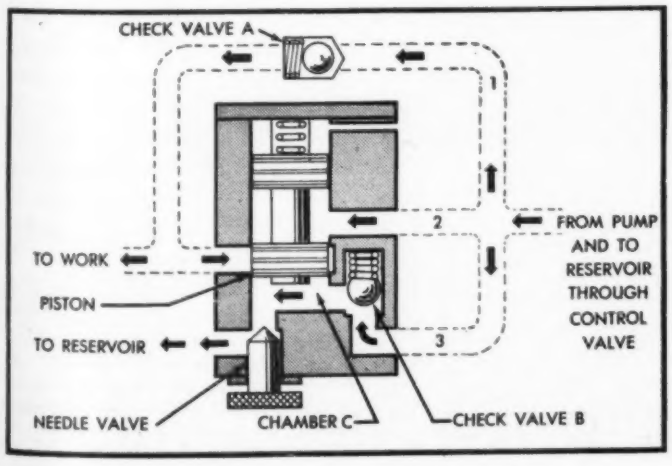
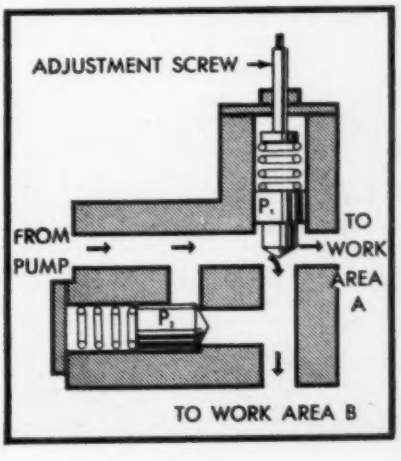


Fig. 103. The "advance" position of a by-pass valve. Oil flows to work area A until pressure compresses spring of plunger P_1, which permits flow also to work area B.



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before the next begins and can be used for two or more cylinders or systems. In operation, the flow runs in one passage until a certain pressure is reached, after which the pressure is carried in addition along a second passage to another work operation. Figures 103 and 104 show, schematically, the advance and return position respectively. In Figure 103, pressure from the pump is directed to work area A or cylinder 1 until a specified pressure is reached. This pressure raises plunger P_1 against the resistance of its spring. Oil will then flow through the second passage to work area B to do other work. This is the situation as illustrated in Figure 103.

Plunger P_1 is held open by a smaller pressure than is needed to open it, because of the greater area against which this pressure then can act. When the position of the four-way control valve is changed to reverse the flow (return position, Figure 104), oil from work area A returns to tank around the smaller diameter bottom half of plunger P_1; oil returning from work area B compresses the light spring behind plunger P_2 opening a passage to tank at minimum resistance. This type of valve can be, and often is used as a relief valve when there is no objection to fluctuations in pressure. When used as a relief valve, the passage to work area A is plugged.

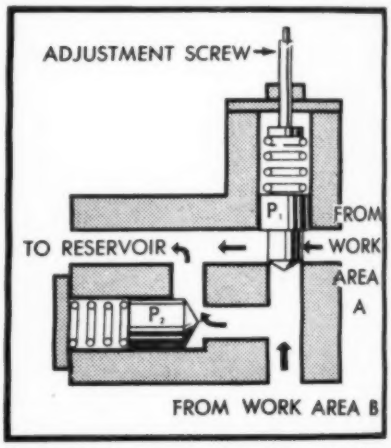

Fig. 104. The "return" position of a by-pass valve. With flow reversed, oil would flow from work area A, past the bottom half of plunger P_1; oil would also flow from work area B, compress light spring of plunger P_2 and past it to tank.

Prefill, back pressure and foot (sequence) valves will be discussed in the next installment. Please save all installments for future reference. In all except very recent issues, copies cannot be supplied subsequent to regular mailing of each issue.

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FOR BETTER HYDRAULIC DEVICES

R/M VEE-FLEX

the packing rings every hydraulic engineer should know and specify

R/M Vee-Flex Packing Rings have been used for years to insure efficient sealing in hydraulic cylinders, rams, pistons, lifts, accumulators, shock absorbers, valves, pumps, and other equipment. They are available in a wide range of sizes for applications in modern hydraulic machinery.

The rings are designed so that fluid pressure automatically spreads the lips and thus increases the efficiency of the seal against rod or stuffing box wall. When pressure is released, the rings contract, thus decreasing friction and making possible longer service.

R/M Vee-Flex Rings nest together in sets, providing a multiple seal in limited space. "Finger-Tight" adjustment is all that is necessary to insure sealing.

Fill out the coupon below for information on Vee-Flex Rings.

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PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Fan Belts • Radiator Hose Powdered Metal Products • Bowling Balls

AP 90

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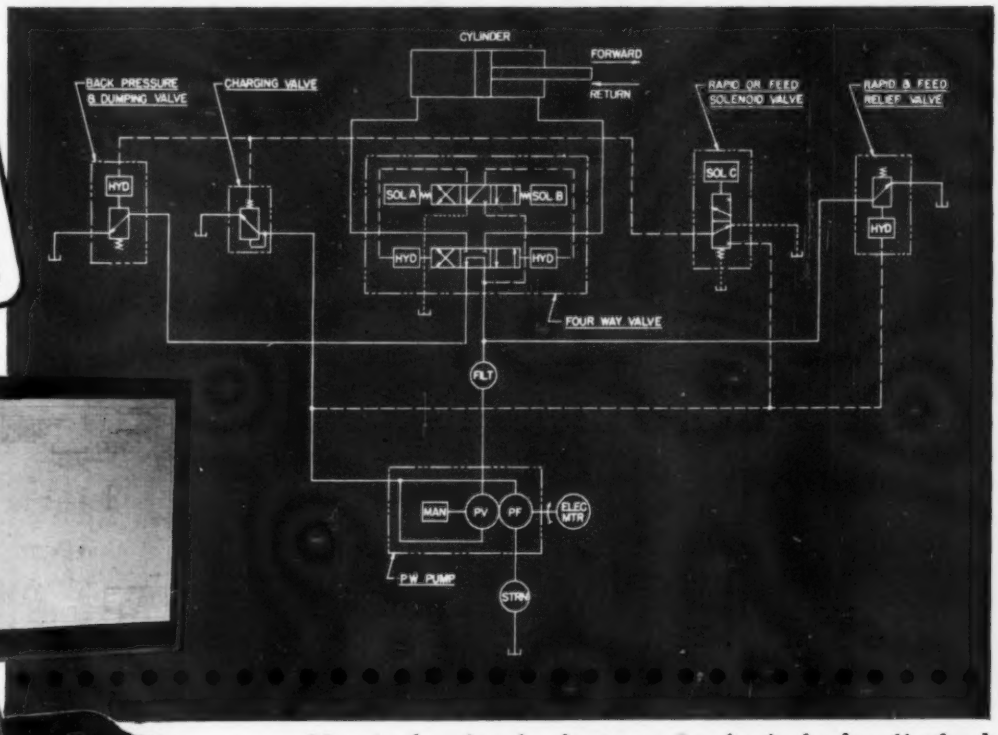
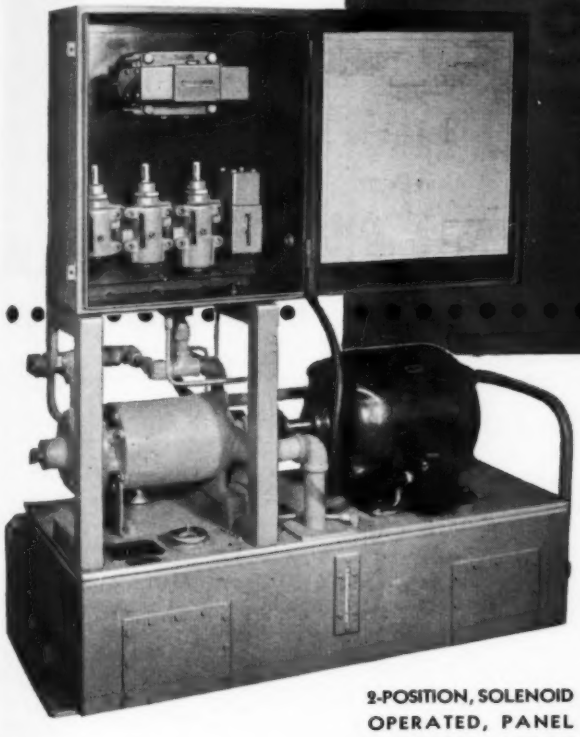
Circle 49 on Reader Service Card

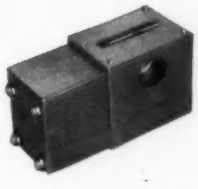
Feed, Rapid Traverse and Directional Control From One SUNDSTRAND "CIRCUIT UNIT"

Designed to J.I.C. Standards

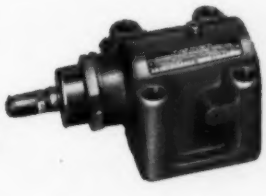




Here's the simple, fast way to obtain hydraulic feed and rapid traverse for your machine. Illustrated is a typical J.I.C. Circuit and the new Sundstrand Hydraulic Power Unit with integral tank. Sundstrand hydraulic elements, also designed to J.I.C. standards, and incorporated in this unit, are shown below.



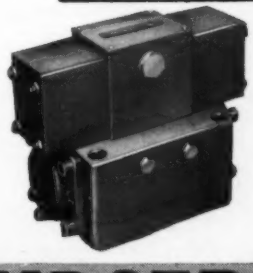
2-POSITION, SOLENOID OPERATED, PANEL MOUNTED 4-WAY VALVE



PANEL MOUNTED RELIEF VALVE

FREE DATA:

Additional data on these self-contained units and components will be sent on request. Write for bulletins AH-57.



3-POSITION, SPRING CENTERED, SOLENOID OPERATED 4-WAY VALVE

PW PUMP FOR VARIABLE FEEDS AND RAPID TRAVERSE

SUNDSTRAND HYDRAULIC DIVISION

SUNDSTRAND MACHINE TOOL CO.

2564 ELEVENTH STREET • ROCKFORD, ILLINOIS

FUEL UNITS • HYDRAULIC PUMPS • TRANSMISSIONS • FLUID MOTORS • VALVES and CONTROLS

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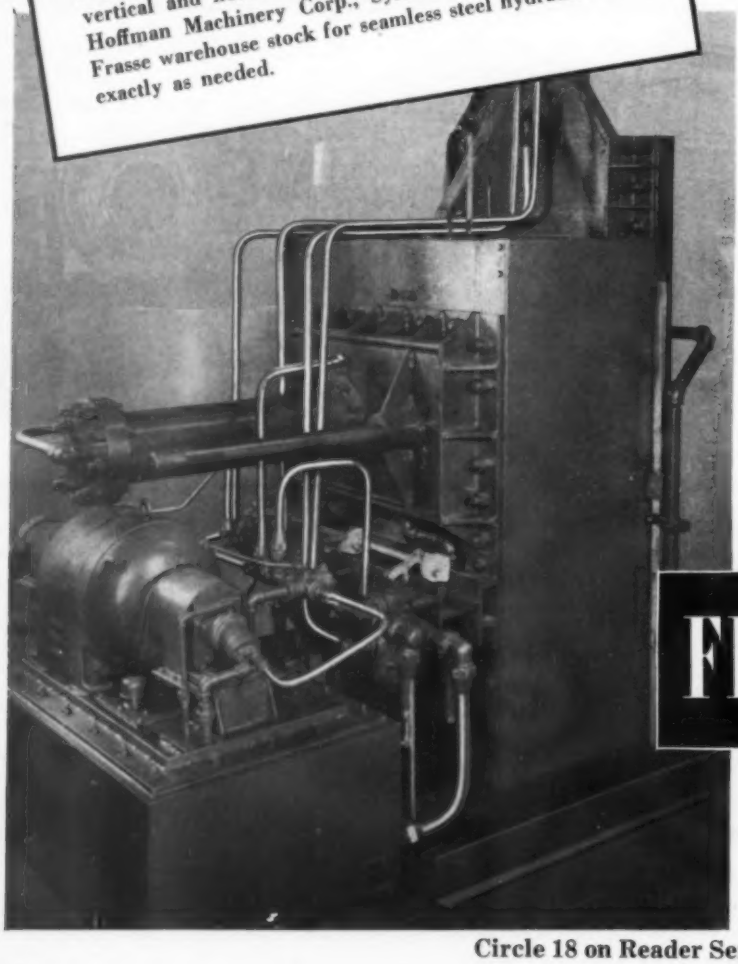
Now! Hydraulic Tubing Immediately Available from Frasse Warehouse Stocks

Tube for your hydraulic systems is now quickly and conveniently available from Frasse warehouse stock. No more waiting for mill delivery promises — no more need to inventory . . . and invest in . . . more tube than is actually required.

Frasse hydraulic tubing is seamless steel, AISI 1010, manufactured in strict accordance with Joint Industry Conference hydraulic standards for industrial equipment. Dead-soft, bright annealed . . . aluminum-killed to insure a non-aging tube of low yield point and unusually high elongation . . . hydrostatically tested to 1000 psi, and conforming to the physical requirement of 55,000 psi maximum tensile.

Call us for further details . . . and be sure to ask for the handy table of recommended working pressures for hydraulic tubing. Fully stocked Frasse warehouses are located in New York, Jersey City, Philadelphia, Buffalo, Syracuse — or write



Fabrication of this hydraulic extractor for large laundries requires several sizes of tubing for its circuits operating vertical and horizontal rams. The manufacturer, U. S. Hoffman Machinery Corp., Syracuse, N. Y., relies on Frasse warehouse stock for seamless steel hydraulic tube exactly as needed.

Peter A. FRASSE and Co., Inc.

17 Grand Street, New York 13, N. Y.

These Hydraulic Tube sizes Immediately Available from Frasse Warehouse Stock

3/8" OD x .035" Wall	3/4" OD x .049" Wall
3/8" OD x .049" Wall	7/8" OD x .049" Wall
3/8" OD x .065" Wall	7/8" OD x .065" Wall
1/2" OD x .035" Wall	7/8" OD x .120" Wall
1/2" OD x .049" Wall	1" OD x .065" Wall
1/2" OD x .083" Wall	1 1/4" OD x .095" Wall
1/2" OD x .095" Wall	1 1/2" OD x .083" Wall
5/8" OD x .049" Wall	1 1/2" OD x .095" Wall
5/8" OD x .065" Wall	1 1/2" OD x .125" Wall
5/8" OD x .083" Wall	1 1/2" OD x .156" Wall
5/8" OD x .095" Wall	

Average Wall
AISI 1010 dead-soft, bright annealed, 55,000 psi maximum tensile

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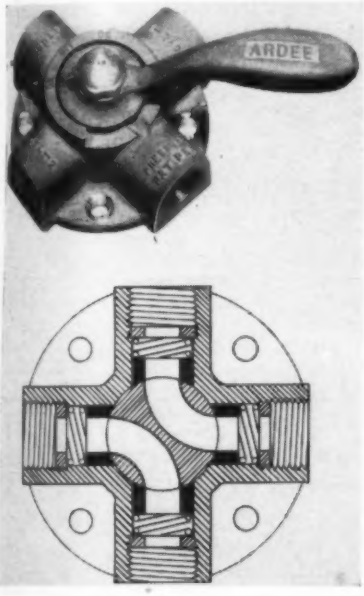
Stainless Tubing, Seamless and Welded
Stainless Pipe, Valves and Fittings

Circle 18 on Reader Service Card

application and performance of NEW COMPONENTS

Manual 4-Way Valve

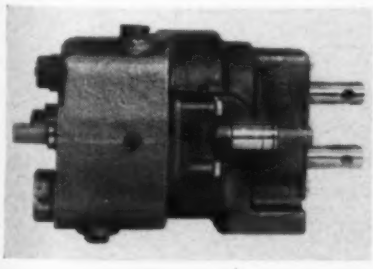
Barksdale Valves have announced that they are ready to market an inexpensive manual 4-way valve, the new ARDEE valve. These units control 150 psi air pressure, and handle liquid pressures up to 1000 psi. Available in pipe sizes ¼ to ¾ in. Their design is a variation on the sealing principle employed in Barksdale high pressure valves. A tubular sealing member slides over peripheral surface of a rotor, maintaining intimate contact during operation of the valve. Pipe scale and foreign material in the line cannot lodge between the sealing surfaces, due to the wiping action of the sliding seal. The four tubular sealing members are molded of various resilient materials suitable for the service requirements. The controlled degree of softness assures a tight seal against the curvature of the mating surface. There is minimum pressure loss through the valve because the round internal flow passages are unobstructed and of the same diameter as the nominal pipe size. Operation of the valve is not affected by vibration.



Circle 49 on Reader Service Card

Hydraulic Pump-Valve Unit

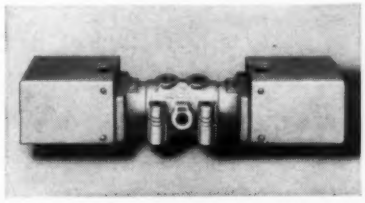
The Commercial Shearing & Stamping Company has recently placed on the market a new oil hydraulic pump-valve combination unit. Known as the B101 Series, it is made in three sizes, 1½, 2 and 2½ in, and can be furnished without relief valve or with single stage or two stage relief valve. Included in this unit is an easy pull action balanced spool control valve having raise, hold and lowering positions. These pumps are designed for use in actuating dump units and recommended for intermittent use with operating pressure up to 1500 psi. Two drive shafts are provided for connection to power take off shaft having either rotation. This series of pumps has gone through exhaustive tests and at present is giving very satisfactory use in the field.



Circle 50 on Reader Service Card

Double Solenoid Hydraulic Valve

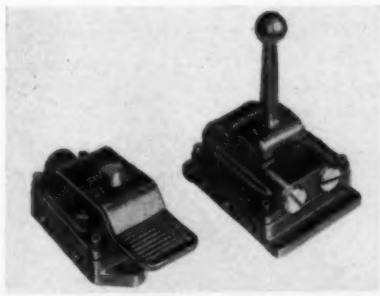
A new double solenoid operated 4-way hydraulic valve has been announced by Rivett Lathe & Grinder, Inc. The new Series 5500 is designed for use as a semi-automatic electric control of a hydraulic circuit. Located at each end of the valve body, the two solenoids are continuous duty push type. Energizing the solenoid on the right moves the valve piston to the left, and vice versa. Principal feature in the new design of the Series 5500 is the hydraulically balanced piston which has an integral spool and stem. The entire piston surface is hardened, ground and lapped with special grooving to minimize possibility of binding under high pressure conditions. Rivett solenoid valves are offered in double solenoid operated type with either standard action or spring centered action; single solenoid operated with spring return; and solenoid pilot operated. Designed for pressures up to 1500 psi the Series 5500 is available in ¼, ⅜, ½, ¾ and 1 in sizes.



Circle 51 on Reader Service Card

Air Valve

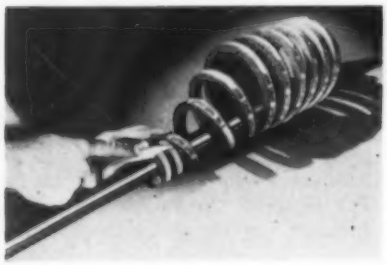
A new air valve for positive control of small cylinder operation is being manufactured by the Ross Operating Valve Company. The new valve is designed for a multitude of uses such as on jigs and fixtures. Chief feature is flexibility due to interchangeability of parts. It can be supplied with a vertical handle, a vertical handle with spring return, horizontal handle with spring return, double treadle foot lever, or single treadle foot lever with spring return. A separate base permits manifold mounting. Bases are available for bottom or side ports. A level seat is standard, but non-level is optional. A two or three position locking arrangement, or non-locking, or a combination can be supplied.



Circle 52 on Reader Service Card

Plastic Packing

Crane Packing Company has added a special new feature to its "Super Seal" plastic packing. A securely vulcanized tape-back is now offered as an integral part of the spiral packings. This development increases packing flexibility and, for the first time, brings a plastic packing into the easy-to-handle class of ordinary braided fabric

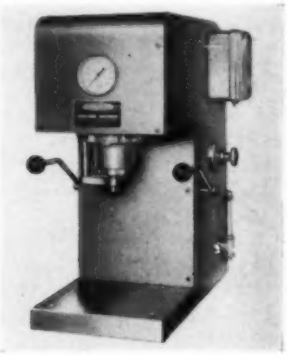


styles. Ring cutting is greatly simplified with this type of reinforcement because the spiral can be twisted down to small shaft sizes, and then cut into rings without breakage. The problem of packing style identification has also been solved with the addition of this tape-back construction. This line of packings is furnished in six different styles to cover the range of operating conditions met throughout industry. They are extremely resilient and homogeneous, and are composed of asbestos, anti-frictional metal particles, flake graphite, and special binders. They do not harden at elevated temperatures and need not be removed as wear occurs. The addition of an additional ring in the stuffing box is sufficient to maintain leak-proof service.

Circle 53 on Reader Service Card

Hydraulic "Han-D-Press"

To its line of air operated "Han-D-Presses" Hannifin Corporation is adding a hydraulic unit available as the F-10 (1 ton) or as the F-20 (2 ton). The new hydraulic press is completely self-contained and can be used where

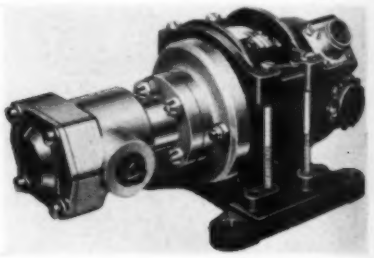


compressed air is not available. Mechanical, dual controls are standard and tamper-proof. Should the operator tie down either control so as to operate the press with one hand, the ram will advance on the first stroke thereafter but will not return, making it impossible to complete the cycle. This same not-return feature when one of the two operating levers is held down makes it possible to "inch" the ram to any desired position and hold it there during set-up work. Stroke of the new press is 6 inches, and gap is 10 inches. Reach is 6 inches, and overall height above the bench is 28 inches.

Circle 54 on Reader Service Card

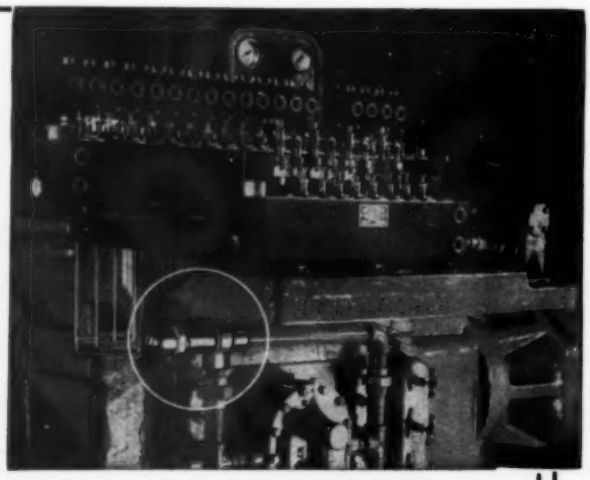
Dry Air Pump

The Aro Equipment Corp. has brought out a new motor driven dry air pump, Model C-10350. This is an integral unit with an electric motor driving a vane type positive displacement rotary air pump. The pump is so designed that it will deliver ½ cfm, an inlet suction of 4 in mercury and an outlet pressure of 1 in mercury. The



pump requires no external source of lubrication, thus no oil fumes are

In Distinguished Company



The photo shows how dependable FULFLO valves are used on this Clark CRA-4 electric driven compressor of 1500 BHP capacity, with good results.

Practically any type of equipment in which constant oil pressures are IMPERATIVE can use FULFLO Valves economically. They're CHATTERLESS; require no maintenance after installation.

Pipe sizes: ¼" to 2" standard pipe thread; STD 300# American flange valves 1" to 2½".

TRADE MARK FULFLO REG U.S. PAT. OFF. Specialties Co., Inc. BLANCHESTER, OHIO

To establish and maintain uniform oil pressures in compressors

CLARK BROTHERS, INC. Olean, New York

USE

TRADE MARK FULFLO REG U.S. PAT. OFF.

BY-PASS VALVES

Write on your letterhead for FREE copy FULFLO MECHANICAL DATA BOOK. No obligation.

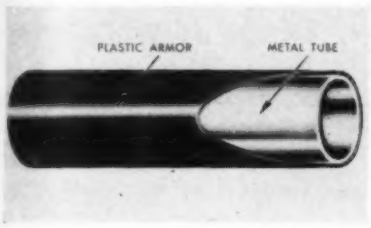
Circle 20 on Reader Service Card

emitted to the atmosphere. The pump is designed to operate satisfactorily throughout an ambient temperature range of from minus 65 degrees F to plus 140 F. Endurance of the unit is checked by rigorous tests for a total period of 150 hours under the following operation conditions: 1) 130 hours total run at ambient temperature 70 F; 2) coldsoak at minus 65 F for a period of 24 hours; 3) remove and immediately check for starting under extreme low temperature condition; 4) 20 hours total run at ambient temperature 70 F.

Circle 55 on Reader Service Card

Corrosion Proof Tubing

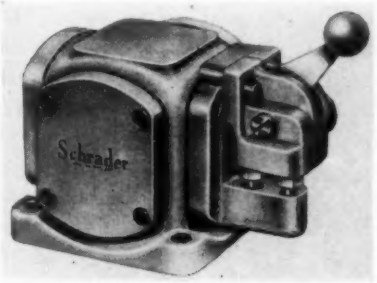
New low cost corrosion-proof instrument tubing made of metal with a 1/32 in coating of extruded thermoplastic has been placed on the market by Samuel Moore & Company. Known as Dekron tubing, the manufacturer claims that the thick, chip-proof plastic coating, made by a patented extrusion process, grips the tube tightly and completely protects the tubing from corrosion danger. The plastic coating is immune to moisture, salt, air, oils, acids and alkalies. Available in ¼ and ⅜ in diameters, Dekron tubing has advantages over stainless steel and other expensive alloys in that it can be bent easily, like ordinary copper tubing, and the plastic coating also serves as color coding for the line.



Circle 56 on Reader Service Card

Air Control Valve

A new design in 4-way air control valves is being announced by A.

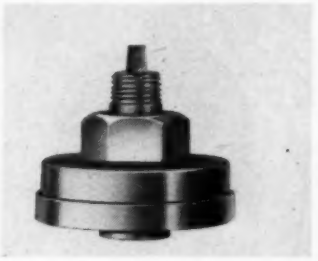


Schrader's Son, Division of Scovill Manufacturing Company, Incorporated. The new valve is ½ in size, specially designed for base mounting with manifold pipe ports for concealment of piping. It is designed for unrestricted air passage of 250 cfm at 100 pounds line pressure. This new design incorporates, as an actuating section, a sliding seal valve, while the main body has a diaphragm sealing action. Operation is so easy, it is claimed that the valve can be manipulated with fingertip control.

Circle 57 on Reader Service Card

Moisture Eliminator

A pet cock which automatically ejects moisture and oil from air brake systems,



air line traps and air compressors, is announced by the Master Equipment Corporation. The new product, called DRAIN MASTER is two inches high and weighs only three and one-half ounces. The device operates on the build up and relief of pressure, automatically ejecting all water and oil, twice for each operation of the equipment. It is made in two models, one for automotive, the other industrial.

Circle 58 on Reader Service Card

CHOOSE THE AIR VALVE YOU HELPED DESIGN

FOR AIR CYLINDER CONTROL
FULL FLOW • COMPACT • ONE MOVING PART
PRECISION SPOOL AND BORE THAT IS
HARD CHROME PLATED FOR EXTRA LIFE
BALANCED TYPE "AIR PRESSURE SEALED"

TWO BASIC
PIPE SIZES
⅜" - ¾"

MAC
MECHANICAL AIR CONTROLS, INC.
5427 HECLA AVENUE
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CAM VALVE · PILOT CONTROLLED VALVE · FOOT VALVE · DOUBLE SOLENOID VALVE · SOLENOID VALVE · TWO PRESSURE VALVE

Write for Catalogue

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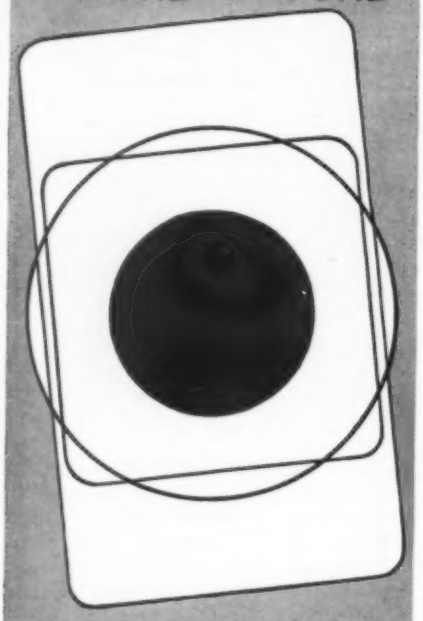
COMPARE
MOUNTING DIMENSIONS
— BORE FOR BORE



SEE WHY
O-M CYLINDERS
PACK MORE POWER
IN LESS SPACE

Tie rods and bulky end caps are eliminated on O-M hydraulic, water, air cylinders. Bore for bore you save at least a third in space required for mounting . . . or you pack more power in the same space.

All body parts are machined steel (not cast). All bearing surfaces bronze. Disassembly and repacking is done in minutes and mountings are interchangeable without disassembly. Ports adjustable to any angle.

A full line available in 1½ to 8 inch bores. Write today for details and specifications.

ORTMAN-MILLER
MACHINE CO., INC.
1204 150th Street, Hammond, Ind.

Circle 22 on Reader Service Card

AIR CIRCUIT FOR CAR WASHER

(Continued from page 20)

shows schematically the method by which a constant flow of high pressure water is made available by boosting that from the city water line. Two enclosed tanks "A" and "B" are incorporated into a single unit and city water is connected through a check valve to the bottom of each tank. An outlet line runs from a point below the respective low water levels to an air pilot operated directional water valve "D". The air compressor receiver is connected to a standard pilot operated four-way air valve "E" which directs or exhausts air alternately to the top of either tank "A" or "B", in the same manner used to govern a double acting cylinder. Float check valves "H" and "J" at the air entrance to each tank serve to prevent water under city pressure from flowing into the air exhaust line at high water level.

At the sides of "A" and "B" and suitably sealed above the high water line are mounted two three-way normally closed air pilot valves "F" and "G" which are controlled by float mechanisms and arranged to release air pressure at low water level. These valves actuate the spool movements of "E" and "D" simultaneously. The circuit is so designed that during normal conditions both tanks may be full at the same time but only one may be empty and, while water is being expelled from one, the other is being filled. The rate of city water flow exceeds the nozzle flow.

The sequence of operations is as follows: Assume both tanks to be full with air pressure on "B" and city water pressure in "A". Float check valve "H" is held closed. Attendant moves lever of directional valve "C" from closed center to clear spray position. Water level in "B" drops until float mechanism opens "G" which shifts spools in "D" and "E". Air pressure is now on "A" while "B" is filling. The cycle repeats to maintain continuous flow.

An automatic soap ejector is placed between Valve "C" and the soap spray. This is adjustable so that the proper amount of detergent may be metered into the line.

OIL COOLERS

(Continued from page 30)

With the installation point of the oil cooler and the maximum conditions established, the approximate cooler size can be established from charts or performance curves available from manufacturers. If conditions vary from the manufacturer's chart conditions, it is necessary to use corrective charts which are furnished with the tables.

With a cooler size selected, the amount of cooling water for maximum conditions can be determined.

As maximum conditions are used in selecting a cooler, experience indicates that system variables will exist in actual operation that will vary the cooling water flow. These are: (1) heat dissipation (Btu/min) due to varying machine output; (2) temperature of the cooling water; (3) ambient temperatures, which alter heat radiation rate; and (4) fluctuations in oil flow (if the oil cooler is not on a separate circuit).

These variables indicate that maximum water flow is required only during peak conditions. Installations are seldom large enough to warrant a cooling tower installation, so waste water is normally used. If the water is dumped directly to drain a savings can be made by installing thermostats to control the water flow to the required amount and a constant desired oil temperature can be maintained.

To summarize, oil coolers are essential on many types of hydraulic equipment including presses, die casting and plastic molding machines, torque converters, variable speed fluid couplings and many other applications where dwells or holding periods permit heat to build up. Oil coolers are also sound investments on many other machines and circuits where oil temperatures may rise above temperatures recommended for operation by builders of hydraulic components.

*****

Acknowledgements

We are indebted to the following manufacturers for assistance in the preparation and presentation of this article: Denison Engineering Company, Harrison Radiator Div., General Motors Corporation; The Hydraulic Press Manufacturing Co.; Reed-Prentice Corporation; Ross Heater & Mfg. Company, Inc. and Young Radiator Company.

ADVERTISERS' LITERATURE

(Continued from page 12)

RESISTOFLEX-CORPORATION. Data on the line of hose assemblies together with information on specific hose problems may be obtained.
Circle 31 on Reader Service Card

GEO. D. ROPER CORPORATION. A catalog providing data on the Roper 3600 series pump is ready for distribution.
Circle 10 on Reader Service Card

ROSS HEATER & MFG. CO., INC. Bulletin 2.2K1 describing and illustrating the design features of the Ross Type CP heat exchanger is being offered by this company.
Circle 6 on Reader Service Card

PETER A. FRASSE AND CO., INC. A handy table of recommended working pressures for hydraulic tubing is being offered.
Circle 18 on Reader Service Card

TOMPKINS-JOHNSON CO. T-J air and hydraulic cylinders, cushioned and non-cushioned types, 100 to 50,000 pounds, are described in available catalogs.
Circle 26 on Reader Service Card

HUFFORD MACHINE WORKS INC. Engineering recommendations and estimates for building hydraulic equipment can be had.
Circle 28 on Reader Service Card

MECHANICAL AIR CONTROLS, INC. Catalog is offered describing the six types of control for their air valves which are offered in two basic pipe sizes, ⅜ and ¾ in.
Circle 21 on Reader Service Card

MILLER MOTOR COMPANY. The Miller square design in air and hydraulic cylinders, is illustrated in bulletins A-105 and H-104.
Circle 8 on Reader Service Card

MEAD SPECIALTIES COMPANY. A new catalog presenting the complete line of compact, spring-return air cylinders is now ready for distribution.
Circle 32 on Reader Service Card

FULFLO SPECIALTIES CO., INC. Included in the new Fulflo Mechanical Data Book are complete descriptions of their oil-relief and by-pass valves.
Circle 20 on Reader Service Card

PETCH MANUFACTURING COMPANY. Information and engineering data will be supplied for Pemaco Hydraulic and air cylinders.
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ADEL PRECISION PRODUCTS CORP. A new descriptive bulletin containing detailed information on Adel's line of industrial equipment is available.
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IN APPROVED STANDARDS FOR MATERIAL, DIMENSIONS AND PROCESSING

- O-ring seal specifications are critical—(tough to meet and tougher to hold)—but standards are set high for important reasons.
GRC O-rings are built to seal—(that's their main job)—and compliance with approved, uniform standards assures they'll do it!
- Compound materials must be clean, consistent and reliable, with variation prevented by continuous laboratory-controlled processing. "Run-of-mill" and "cheap" compounds can't be tolerated—specification "tailored to fit" compounds are the only answer.
GRC O-ring compounds are designed to withstand a wide range of conditions—(air, water, oils, aromatic fuels, gases, refrigerants, ammonia, heat, cold, pressure, vacuum, friction, twist, and even beer, to mention a few)—and superior results are assured by their use.
- Dimensional tolerances are close, with practically no flash permitted and with circular sections mandatory. Off-size, out-of-register and oval-sectioned parts won't seal well nor long, if at all.
GRC O-rings are produced only from quality molds, trimmed carefully and passed through a rigid inspection to assure an accurate, precise and dependable seal.
- Processing methods are standardized — (raw material pre-forms, compression molding, fixture trimming)—to insure long-life service.
GRC O-rings are processed in accord with procedures tested and specifically recommended for O-ring production, based on Air Force-Navy research. "Short-cut" methods have their place but it's not in quality O-ring manufacture.

• • • •

The AN123851-AN123950 (oil-resistant AMS7274) and AN123951-AN124050 (fuel-resistant AMS7270) series O-rings from approved compounds and in all sizes have been added to the GRC precision seal line. Your inquiry concerning these O-rings will receive prompt attention.

For AN6227, AN6230 and AN6290 series "O" ring data, write for your free copies of Catalog "C" and Bulletin P-112.

Goshen Rubber AND MANUFACTURING CO., INC.
MOLDED RUBBER SPECIALTIES, WASHERS
QUALITY MECHANICAL RUBBER GOODS FOR 34 YEARS
1523 SOUTH TENTH STREET • GOSHEN, INDIANA

Circle 23 on Reader Service Card

Useful Catalogs and Bulletins

available for reference

Hydraulic Accumulators . . . Made to store hydraulic oil under pressure for the actuation of hydraulic devices where the demands of the system are intermittent, Vickers accumulators, described in Bulletin 50-56, provide high oil flow capacity for relatively short cycles of operation. The one piece and seamless alloy steel shell is designed for a high hydrostatic bursting pressure, all sizes are tested to 8500 psi. Because of the swedged or rolled neck construction, pressure in excess of 15,000 psi causes the lobe to expand permitting obvious leakage and retarding further increase in pressure. The result is an exceptionally high safety factor when using 3000 psi working pressure. The design of the accumulators follows the practice recommended by JIC hydraulic standards for industrial equipment. Maximum operating pressure is 3000 psi. The bulletin presents available sizes and details a typical installation.

Circle 59 on Reader Service Card

Hydraulic Pump . . . Feed, traverse and directional control is obtainable from the PWX series of Sundstrand hydraulic units described in a recently released catalog. The PWX series of units consist of a variable displacement multi-piston pump for feeding, a constant displacement pump for rapid traverse and the main control valves all in one housing. Thus, complex circuit control is obtained from one compact unit and the piping required between the main control valve, the feed pump and the rapid pump is eliminated. The main control valves in the unit may be actuated by either a remote hydraulic pilot valve or a remote electric solenoid valve. Remote control valves, in turn are actuated by the machine's moving member as it progresses through its cycle. The pumping unit may be used with either a piston and cylinder combination or a rotary fluid motor to transmit motion to spring members of a machine. The catalog includes detailed engineering drawings.

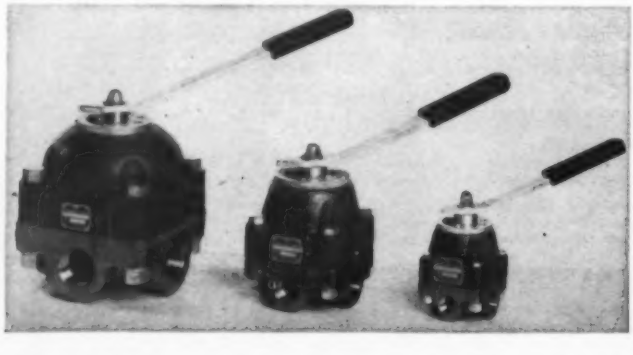
Circle 60 on Reader Service Card

"O" Rings . . . Starting with a guide to comparative general properties of natural and synthetic rubbers, Arrowhead Rubber Company's Catalog 502A, provides a complete discussion on the application and design of "O" rings. Special "O" rings can be fabricated from any elastometer when specific properties are

BARKSDALE VALVES

"ARE SAVING US SEVERAL THOUSAND DOLLARS A MONTH"

This statement from a Die Casting firm is noteworthy because savings in reduced maintenance and down-time dwarf the cost of control valves * in high pressure installations.



The new series of manual 4-way valves (illustrated) employs the same basic tubular seal design (low maintenance — leak proof — easy operation) which made earlier models famous. Here are some additional features of the new design: Increased flow capacity; lower handle loads; same valve may be switched from "open center" to "closed center"; same valve for panel or regular mounting; choice of Regular porting (in the run of the line), Straight porting (all four lines brought into the end) or Manifold porting (for sub panel mounting).

*You can't buy a better valve than a Barksdale—to control Water, Air or Oil—to 6000 psi. pressure.

Write for literature and recommendations.

BARKSDALE VALVES

4905 Santa Fe Ave., Los Angeles 58, Calif.

Circle 24 on Reader Service Card

BETTER BRONZE PARTS FOR ALL TYPES OF PUMPS

American Crucible methods, know-how, experience and equipment result in highest quality parts at attractive savings to you.

PROMET THE Engineered BRONZE

thrust plates, bearing plates, pressure plates, bushings, seals and connecting rods, machined or rough cast, of the specific formula best suited to each application, carry a

MONEY-BACK GUARANTEE OF LONGER SERVICE—LOWER MAINTENANCE COST.

Write for literature or let us make recommendations and quote you. Simply send blueprints, conditions of operation and other data.

PROMET BRONZE BAR STOCK

Round, solid or tubular. Rough cast or fully machined. Cored stock all sizes (by ⅛" steps) from ¾" minimum core to 26" O.D. and 13" lengths or less. Six grades of hardness.

DEALER! Write for attractive proposition.

THE AMERICAN CRUCIBLE PRODUCTS CO.

1303 Oberlin Avenue • Lorain, Ohio

Circle 25 on Reader Service Card

indicated by unusual application. Two series of "O" rings are available. Series 6227 is used for applications involving reciprocating motion, partial rotation or static sealing. The 6230 series is usually restricted to static sealing. Both series can be supplied in Army-Navy grade and commercial hydraulic grades. Leather back-up rings are used to extend life and prevent destruction of "O" rings under high pressure applications. Dust excluders protect against entrance of abrasive materials into the gland assembly. Drawings showing the relative position of "O" ring packings in different grooves at increasing pressures illustrate the value of back-up rings. Clearances, groove design, squeeze, and surface requirements are amply detailed.

Circle 61 on Reader Service Card

Pressure Reducing and Regulating Valve . . . Bulletin 1009 released by M-B Products Company presents construction and operating data for their line of automatic pressure reducing and regulating valves designed for air applications. Available in ¼, ⅜, ½, ¾ and 1 in port sizes, the aluminum body provides a compact, light weight unit. The bronze adjusting screw, with sturdy T-handle, facilitates instantaneous adjustment for secondary pressures ranging from 3 to 130 pounds. The neoprene valve seat is of extremely simple design and easily removed. The neoprene diaphragm is capable of passing a large volume with an unrestricted flow and with a minimum amount of pressure drop.

Circle 62 on Reader Service Card

Metal Hose and Tubing . . . Quick reference catalog CC 300 presents the products of American Metal Hose Branch of the American Brass Company. The two basic types of flexible hose and tubing are seamless, made from tube, and strip wound made from strip metal. The seamless construction is made from joints, laps, welds, seams or packing which makes it, in effect, a flexible pipe that can be relied upon for services where complete tightness is essential. It is widely used for connecting moving parts of machinery while conveying steam, oil, liquids and gases under pressure; for absorbing vibration in rigid pipe lines; connecting misaligned ports; piping in cramped spaces and other uses involving continuous or intermittent flexing. A principle type of strip construction is full interlocked which is made in steel for conveying oil. Also available in strip metal construction are ball bearing, square locked, unpacked interlocked and vacuum hose.

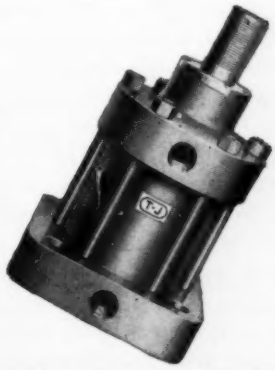
Circle 63 on Reader Service Card

Heat Exchanger . . . Tables and examples for computing oil and water cooling capacities are offered in Young Radiator Company's Catalog 1149. Recommended for a variety of cooling applications including industrial hydraulic equipment, pumping units and machine tools, these high performance exchangers are available in a wide range of sizes and models. They are designed to perform under a maximum operating pressure of 75 psi and temperatures up to 300 F. Special construction features include corrosion-resistant Admiralty metal tubing, larger tube sizes (⅜ OD and ⅝ OD) and engineered tube spacing, provide longer life and easier maintenance.

Circle 64 on Reader Service Card

Industrial Control Devices . . . Minneapolis Honeywell, Brown Instrument Division, control devices for temperature pressure, flow, liquid level and humidity are fully described in Catalog 8303. Control systems are broadly classified by considering the medium through which the control is secured. Such a classification indicates three general types: electric control systems where the primary actuating medium is electricity pneumatic control systems in which compressed air is used as the actuating medium. This booklet offers a glossary of control terms and an analysis of types of control; two positions, floating and proportioning.

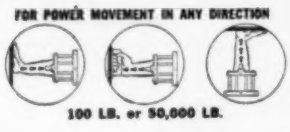
Circle 65 on Reader Service Card



All moving parts are controlled hydraulically by T-J Cylinders—on this Malleable Nut Production Machine designed and built by Roy Hays & Associates, Rockford, Ill., for the Wagner Malleable Products Co., Decatur, Ill.

It's *fully automatic*—the operator only places nuts in stations. Nine T-J Cylinders, 40 ton to ½ ton, help complete the job of cutting off sprue, sizing, boring, facing, chamfering and threading 2,500-¾ std. pipe thread nuts per hour.

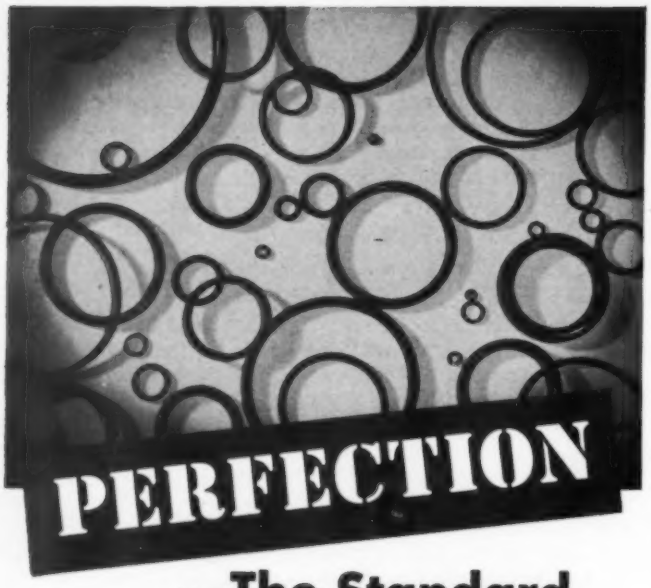
For your tough jobs of power movement—pushing, pulling or lifting—*save labor, speed production* and *cut costs* with T-J Air and Hydraulic Cylinders! Many standard sizes and styles . . . both cushioned and non-cushioned types . . . 100 lb. or 50,000 lb. Precision-built for long-life dependability. Write for latest catalogs. The Tomkins-Johnson Co., Jackson, Mich.



T-J
TOMKINS-JOHNSON
RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

33 YEARS EXPERIENCE

Circle 26 on Reader Service Card



--The Standard of Quality in ARROWHEAD "O" RINGS

This high standard of quality is possible because of Arrowhead's years of experience in the precision molding of "O" rings. Vigilant quality control from rubber compounding to finished product, and rigid inspection procedures constantly maintain this standard.

Standard "O" Rings Arrowhead "O" rings are available from stock in all sizes and in both Commercial and AN grades. In both grades are types designed for applications involving reciprocal motion, partial rotation and static sealing in both hydraulic and pneumatic uses.

Special "O" Rings For unusual requirements of temperature, resistance to highly corrosive substances, or other highly specialized operating conditions, Arrowhead's research laboratory will develop special compounds to meet the particular requirement.

Whatever the sealing problem, Arrowhead engineers and rubber technicians will welcome the opportunity to offer advice and assistance.

WRITE FOR "O" RING MANUAL

This valuable booklet contains comprehensive data on the use and installation of "O" rings, as well as illustrated information on the design of mechanisms for the proper use of this type seal. Write today for Catalog 502A

ARROWHEAD RUBBER CO.

DOWNEY (Los Angeles County) CALIF.

DIVISION OF NATIONAL MOTOR BEARING CO., INC.

Sales Engineers in Principal Cities

"O" RINGS • SILICONES • PRECISION MECHANICALS • [illegible] DUCTS

Circle 27 on Reader Service Card

Packing Adaptors . . . A new brochure issued by the Gilson Company, Inc., gives dimensions and information on the new Rodgers packing adaptors for Vee type packings, for air or hydraulic service. These bronze adaptors are being offered with a choice of either a 90 or 100 degree included angle. The outside and inside diameters as well as the cross sections are the same as those discussed as desirable standards for Vee type packing by the JIC. The stack heights or contact heights for both the male and female adaptors are the same as the AN standard stack heights for use with Vee packings.

Circle 66 on Reader Service Card

Hose Fittings . . . A new 12 page catalog section on the hose couplings and fittings of various types which it markets has been published by the B. F. Goodrich Company. The catalog section pictures and gives details on each type coupling and fitting, together with specifications, general and maximum pressure recommendations and a description of threads. The products include: common couplings, short and long shanks; combination nipples, special suction hose couplings, including the quick action type, interlocking high pressure couplings; hydraulic hose couplings and hose adapter unions; permalock couplngs; flexseal hose joint and Bar-way reattachable fittings.

Circle 67 on Reader Service Card

Air Filters . . . A guide to good cleaning and filtering of compressed air is offered by the R. P. Adams Company Inc. in Bulletin 176. Protection of pipe lines, air instruments and nozzles is emphasized along with the advantages of increased efficiency in compressed air equipment and decreased maintenance problems. Moisture in air systems creates a freezing problem, causes corrosion and reduces carrying capacity. A pipe line aftercooler introduced in the air system after compression, condenses the vaporized water and oil which are then completely removed by the centrifugal action of a separator. Reducing the temperature decreases the ability of compressed air to

if it can use hydraulics

Wherever mechanical motion is required, there's a possibility of using Hydraulics to advantage—for economy, speed, smoothness, or greater operating efficiency.

HUFFORD, one of the Pacific Coast's leading exponents and builders of Hydraulic Equipment, can help you. For engineering recommendations and estimates, *call on us.*

HUFFORD MACHINE WORKS, INC.

Redondo Beach, Calif.

Builders of the famous Hufford Hydraulic Stretch-Wrap Forming Machines, Hydraulic Ceramic Presses, Hydraulic Elevators, and Specialized Hydraulic Machinery.

Circle 28 on Reader Service Card

hold moisture. Poro-stone filters designed to protect instruments and tools are also discussed in the folder.

Circle 68 on Reader Service Card

Control Valves . . . Electraulic valves designed for working pressures up to three tons per square inch are described in an available folder. Hand operated valves are hydraulically balanced, laterally and axially, giving effortless control. They can be arranged for any cycle of press operations and may be mounted at any angle and at whatever location is most suitable to the press operator. The fingertip control valve may be supplied as a pilot-operated valve with the addition of the pilot piston. This valve may then be employed for the control of hydraulic presses using a completely automatic or semi-automatic cycle of operation. These valves include such features as packingless piston, decompression and pump unloading. The line includes solenoid operated valves, flow control valves suitable for machines which are required to work at varying speeds, and relief valves which have a special damping device, permitting instantaneous response to a rise in pressure, but providing a hydraulic cushion to absorb violent pressure fluctuations.

Circle 69 on Reader Service Card

Photoelectric Counters . . . Photoswitch Photoelectric Counter Set P2C is one of several photoelectric counter combinations offered by Photoswitch Inc. These are described in Bulletin PA 506 which has just been made available for distribution. This counter set consists of photoelectric control with phototube and light source located in small remote housings. It features simplicity of installation. No wiring is necessary. The control is powered through a line cord with a male plug connection which fits any standard lighting outlet. This supplies the power as well for the light source, electric counter, and photoelectric scanner.

Circle 70 on Reader Service Card

The ANSWER
to controlling air electrically!

MODEL NE
Electric
VALVE

10 WATT SOLENOIDS—Low power requirements. No relays, no transformers required. Operates directly off regular 110 or 220 v. circuits. Solenoids continuously rated.

FAST, EFFORTLESS CONTROL—Works by push button, limit switch, or any light contact. Only momentary contact needed. Ideal for remote control . . . interlock or sequence operation . . . building into equipment.

DISC TYPE—Pilot controlled; piston operated. Metal-to-metal seat; positively air-tight. Quiet, self-lapping, long lasting. No packing or seals to maintain.

HANNIFIN ENGINEERED—Small, rugged, self-contained. Type 1 for control of advance and return cylinder strokes through separate push buttons. Type 2 for single push button control—equivalent to spring return valve action. Sizes ⅜", ½", and ¾". 25 to 150 p.s.i.

Ask for Bulletin 230

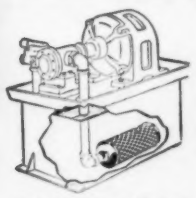
HANNIFIN *Corporation*

1155 So. Kilbourn Avenue • Chicago 24, Illinois
Nationwide Sales and Service

Circle 29 on Reader Service Card

SUMP TYPE
(Cutaway)

NOW OVER 150
Manufacturers Make



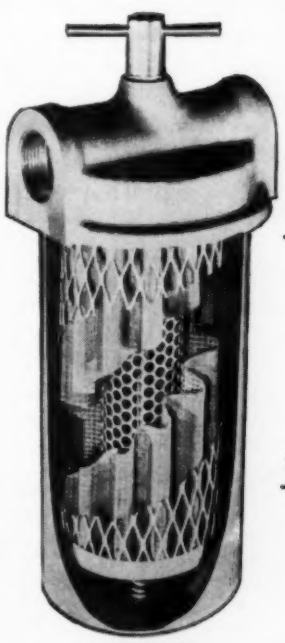
Typical Sump Installation

MARVEL SYNCLINAL FILTERS

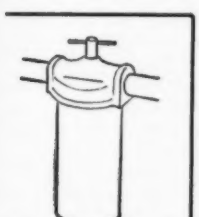
Their O.E.M. Choice

For HYDRAULIC EQUIPMENT where oil MUST BE CLEAN

These efficient, versatile filters adapt readily to all installation needs, give more filtering area in same space than like size circular units. Both sump and line types operate at full efficiency in any position and can be installed at the angle most convenient for your machine. Either type may be disassembled, cleaned and reassembled in minutes. Removing a single handnut releases the line model housing for quick cleaning without disturbing pipe fittings. Adaptable to your needs in every way. Marvel Synclinal Filters may be had with wire mesh sizes from coarse 30 to fine 200. Individual capacities are from 5 to 50 g.p.m., and greater capacities are obtainable by multiple installations.



LINE TYPE
(Cutaway)



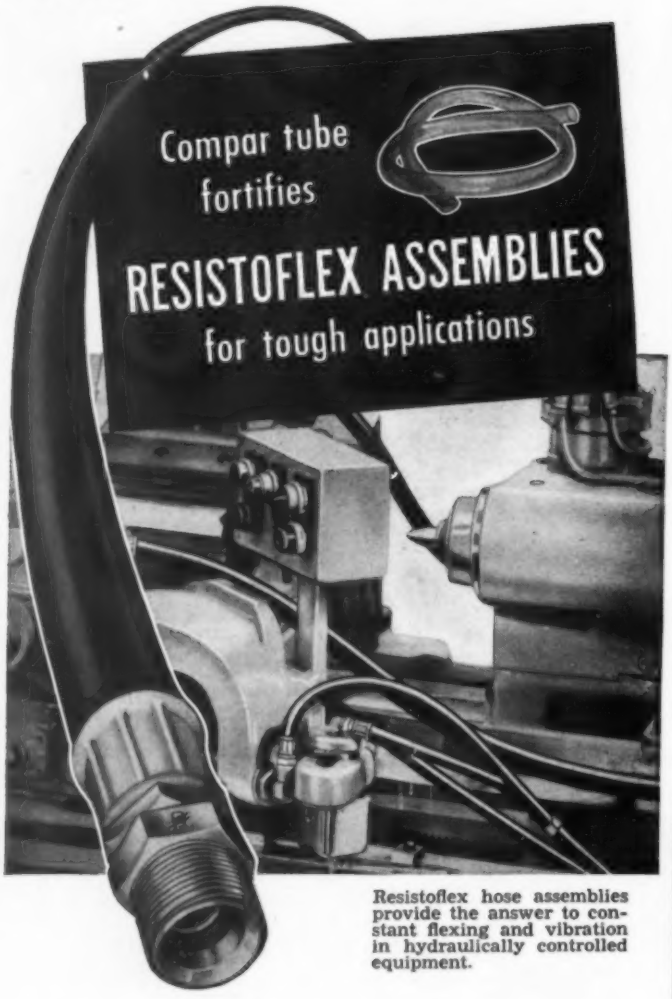
Typical Line Installation

For efficient filtration of liquids in all HYDRAULIC or LOW PRESSURE circulating systems Marvel has your answer. Write for catalogs 104 and 202.

MARVEL ENGINEERING CO.
625 W. JACKSON BLVD., DEPT. 86 CHICAGO, ILL.

Circle 30 on Reader Service Card

Extra Strength in this Oilproof Hose!



Resistoflex hose assemblies provide the answer to constant flexing and vibration in hydraulically controlled equipment.

THREE REASONS explain why more and more manufacturers standardize on Resistoflex Hose Assemblies. These lines, containing no metal reinforcements, have: (1) Superior flexibility and are fatigue-proof. (2) High burst strength for medium as well as low pressure installations. (3) Complete impermeability to oils. All these advantages, of course, add up to fewer service troubles and replacements.

The extra durability of Resistoflex hose is assured by its unique construction. It has the compar tube. This high tensile tube not only reinforces the hose against shock loads, but also helps maintain clean systems because it doesn't swell, gum or erode in contact with oils.

If you have an application involving flow of hydraulic, lubricating or water-insoluble cutting oils, it will pay you to learn more about these light, cost-cutting, compar-tubed lines. Other assemblies available for gases, refrigerants or tough solvents. Write us about your problem, or for more information.

RESISTOFLEX
CORPORATION

Belleville 9, New Jersey

SYNTHETIC FLEXIBLE PRODUCTS AND PARTS FOR INDUSTRY

Circle 31 on Reader Service Card

Air Cylinders . . . Catalog 100, Section 1, Logansport Machine Co., gives dimensional data for the seven types of mounting arrangements which provide the user with a suitable mounting to fit his application for stationary air cylinders. Cylinders can be had with or without cushioning. Standard bore sizes range from 1½ in to 16 in and strokes are available to 18 feet for operating pressures to 150 psi. Rotating air cylinders are designed to permit full pipe capacity through air shaft and internal passages, resulting in fast unrestricted cylinder action. To provide a leakproof seal, piston cup packings are uniformly expanded by air pressure, eliminating uncertain hand adjustments. A follower supports the cups, increasing their life and maintaining piston alignment. Three standard types of Logan rotating air cylinders are described.

Circle 71 on Reader Service Card

Piston Ring . . . Fourteen types of Pedrick piston rings are pictured in a catalog offered by the Wilkening Manufacturing Company. The applications and merits of stepped, beveled, tapered, channeled, three piece and two piece rings are included. Of particular value to design engineers are charts showing the number and size of holes required for drainage in oil ring grooves for given ring width and diameter.

Circle 72 on Reader Service Card

Oilless Bearings . . . A new catalog for the Wakefield Bearing Corporation is now ready for distribution. The development and diversification of products are headed by three major groups: coprex, graphex and woodex. Eleven numbered alloys illustrate several alternate uses for bearings on the solid lubricant principle. In general they are designed to operate with or without the benefit of periodic petroleum lubrication. Alloy 15 is a graphited babbitt metal highly favored by some pump manufacturers. Also it is particularly valuable where babbitt bearings are desired and where certain self-lubricating properties are needed for safety factors in the event of oil failure.

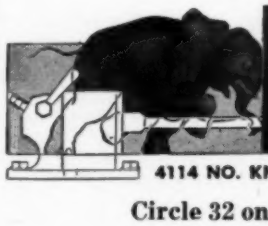
Circle 73 on Reader Service Card

SINGLE-ACTING
AIR
CYLINDERS

Bore	Strokes	
	Horizontal	Vertical
1"	⅝"	⅝"
2¼"	1" 2" 3"	1" 2"
3"		½" 2"
4"	2" 2½"	2"
5"	3"	3"
6"	3"	2"

NEW CATALOG READY!

Complete line of simple, adaptable, compact spring-return air cylinders. Cut costs and speed up production the *modern*, Air Power Way. Write today.



MEAD
SPECIALTIES COMPANY

4114 NO. KNOX AVE., DEPT. AH-90, CHICAGO 41, ILL.

Circle 32 on Reader Service Card

Hydraulic Valves . . . Five piston designs to meet the requirements of any hydraulic circuit are offered in the valves described by Gerotor Catalog 202, issued by Rivett Lathe & Grinder Inc. These 4-way valves are suitable for oil service at pressures up to 1500 psi. Valves can also be furnished for 3000 psi oil service. Gerotor 4-way hydraulic valves are supplied in many styles; four types of action—standard, spring return, spring centered, and ball dedent; and six types of operation—hand, cam, foot, solenoid, oil pressure and air pressure operated. Fully detailed cross-sectional drawings are included to facilitate proper valve selection.

Circle 74 on Reader Service Card

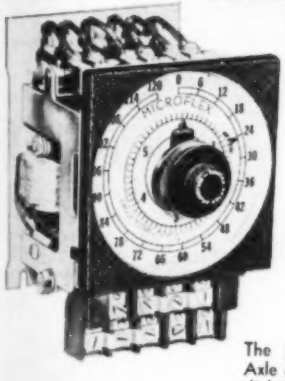
Pilot Type Relief Valves . . . Principle of operation and flow characteristics of "pilot" type relief valves are discussed in a Hydraulics Notebook sheet offered by Fluid Controls, Inc. A "pilot" type valve employs a small valve, or pilot, to control the operation of a larger, or main valve. Since the main valve is responsive only to the flow through the pilot, it positions itself to maintain this pilot flow constant. Any change in pressure at the pressure port effects the flow through the pilot which in turn effects the main valve, in this way the pressure is held constant regardless of the flow through the valve.

Circle 75 on Reader Service Card

Air Cylinders . . . Along with specifications and drawings, Catalog 43 offers informative tables and rules for the proper selection of Tomkins-Johnson air cylinders. A discussion on the use of cushioned cylinders and the principles of operation will assist the user in their proper application. Seven types of cushioned and non-cushioned cylinders are available. Features of these cylinders include hard chromium plated cylinder bores and piston rods, cylinder bores honed prior to hard chromium plating, shouldered piston rods, self sealing packings throughout, metal to metal type pistons, followers used on all size cylinders to hold the packing firmly against the piston, and box type pistons for cylinders larger than 5 in diameter.

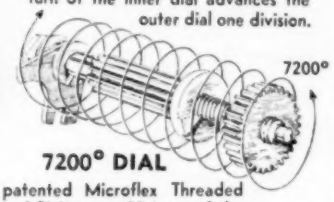
Circle 76 on Reader Service Card

Eagle MICROFLEX
RESET TIMER



MICRO TIME SETTINGS

The double Microflex Dial permits setting the timer right on the dot—like a Micrometer. One complete turn of the inner dial advances the outer dial one division.



7200° DIAL

The patented Microflex Threaded Axle and Pinion uses 20 turns of the dial. Multiplied 20 times, 7200°, for more accuracy.

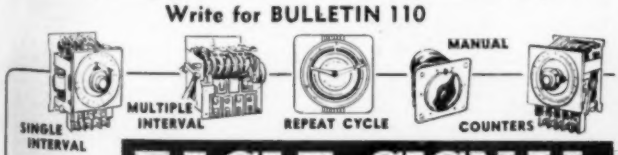
•WIDER RANGE OF ADJUSTMENT

Your machines equipped with Microflex Timers will have added utility. Jobs requiring short or long time period can be accurately controlled by setting the Micro Dial.

•OVER 100 TIMER OPERATING COMBINATIONS

Each one of the three separate Microflex contacts can be set for seven different actions. Selection of the exact combination desired will eliminate additional relays.

Write for BULLETIN 110



AN EAGLE TIMER FOR EVERY TIMING PROBLEM!

EAGLE SIGNAL CORPORATION Moline, Illinois

Circle 33 on Reader Service Card

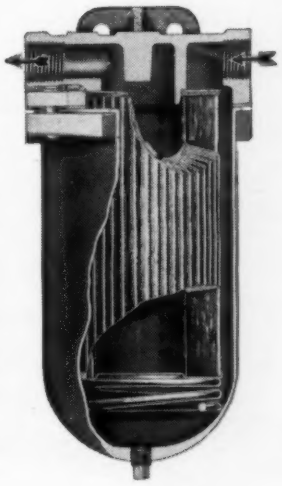
Bendix-Skinner

ORIGINATOR OF **MICRONIC** FILTRATION

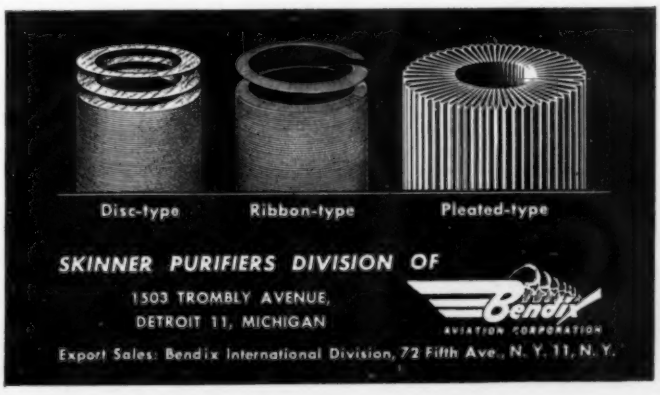
Results Prove It

the Finest Name in Filtering

Nine times out of ten ***Bendix-Skinner*** Filters will supply the "finest" answer to your filtration problems. Here are the facts: available with patented, exclusive, resin impregnated cellulose elements; simple, quick replacement; high flow rate with minimum pressure loss; no channeling or bypassing; over 350 models providing filtration from ½ micron (.000019") upwards at flow rates from 1 to 5000 g.p.m. Why not let ***Bendix-Skinner*** filtration engineers work with you? Write us direct.



Model 3110-P filter element, 6⅛" x 3½", has a filtering area of 940 sq. in.!



SKINNER PURIFIERS DIVISION OF
1503 TROMBLY AVENUE,
DETROIT 11, MICHIGAN
Bendix AVIATION CORPORATION
Export Sales: Bendix International Division, 72 Fifth Ave., N. Y. 11, N. Y.

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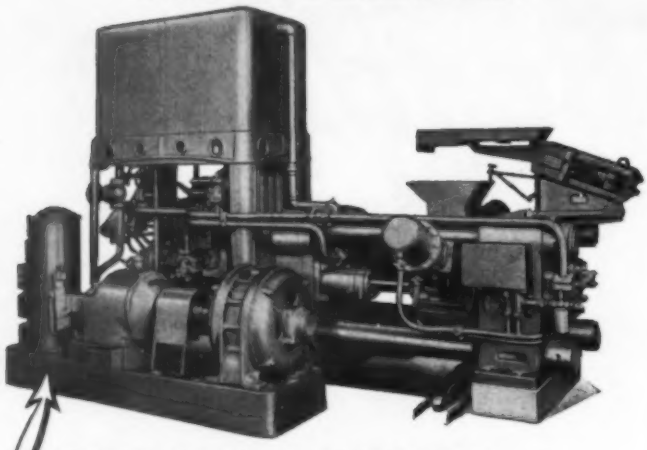


MILWAUKEE FOUNDRY Specifies
Honan-Crane for Hydraulic Oils

On the hydraulic briquetting presses produced by Milwaukee Foundry Equipment Company, Honan-Crane oil purifiers are specified for continuous purification of hydraulic oils.

Complete and satisfactory protection of pumps and precision parts of hydraulic system is assured by continuous purification. Press maintenance and down time due to dirty oil is eliminated.

For full information on low cost purification and maintenance of hydraulic oils, write to Honan-Crane Corp., 102 Wabash Ave., Lebanon, Indiana, subsidiary of Houdaille-Hershey Corporation.

NEEDLE BEARINGS

(Continued from page 21)

Computation of Bearing Loads

In establishing a suitable and quick method for the satisfactory solution of bearing loads in gear pumps, it is known that such loads are the resultant of two separate forces—the tooth force to drive the driven gear and the hydraulic force due to the differential pressure between the suction and discharge ports. Each of the above forces are resolved into several components to permit a rapid determination of the resultant load due to the tooth and hydraulic force. Derivation of the formulas for the various component forces requires the assumptions that:

(1) The pressure increases uniformly from suction to discharge.
(2) The suction angle equals the discharge angle.
(3) The discharge cavity and suction cavity are areas of constant pressure.
(4) One-half of the Input Torque to the Driver Gear is used to drive the Driven Gear.
(5) One-half of the total Sealing Force acts on each gear.
(6) The effect of the Separating Force, due to the tooth load to drive the Driven Gear, on the Resultant Force is negligible for both gears.

Basing the derivations on the above assumptions, the formulas for the resultant forces are:

(Continued on page 54)

PEMACO HYDRAULIC AND AIR CYLINDERS
Designed to J.I.C. Hydraulic Standards

PEMACO HYDRAULIC CYLINDER

The reputation enjoyed by PEMACO for building first quality hydraulic and air cylinders was not acquired by chance. Sound engineering, modern design, the finest materials combined with years of experienced craftsmanship, has resulted in recognized acclaim throughout industry

Check these 11 points of superiority of the PEMACO HYDRAULIC CYLINDER:

- "Heavy duty" hi-tensile cast iron castings (steel castings optional).
- Ample bronze bearing—oriented behind packing to reduce surge pressure.
- New type, low friction ram seal.
- "Seal guard" ram scraper gives positive packing protection.
- 50 Rockwell — hardened and grounded steel ram — score resistant.
- Automotive type piston rings.
- "O" ring seals.
- Internal snap type keeper ring.
- Piston and ram positively secured by patented lock nut.
- Precision honed steel tubing.
- Designed to J.I.C. Hydraulic Standards.

PETCH MANUFACTURING COMPANY

Write for complete information and engineering data.

2769-71 HARPER ST.
MT. CLEMENS, MICH.

Circle 36 on Reader Service Card

NEW BANTAM SIZE AIR VALVES
Save Space . . . Save Maintenance

EVERY ONE of the valves pictured here is a new Schrader design. All have these important advantages over conventional valves:

COMPACT—Smallest on market. Lever valve, for example, mounts on area less than 1 3/8" x 1 11/16".

LOW IN MAINTENANCE—Minimum of parts, all easily replaced. Principal wearing parts are interchangeable, reducing maintenance inventory.

RUGGED IN DESIGN—Valve bodies are drop-forged brass for longest life.

EASY TO OPERATE—Sliding seal makes them easy to operate.

New 3-way valve for operating air clamps or small bore single acting air cylinders.
New hand lever valve available in 2, 3, and 4-way and, with another lever, for mechanical actuation.
New 2, 3, and 4-way spring return valves. Holes for bench, floor or wall mounting.
New 2, 3, and 4-way spring return valves for foot operation. Foot guard prevents accidental tripping. One-step or two-step operation.

Write for full information and literature about Schrader Air Valves. For information about hundreds of other Schrader Air Control Products... Air Cylinders, Pilot Valves, Air Filters, Press Controls etc., ask for 72-Page Catalog.

A. SCHRADER'S SON
470 Vanderbilt Ave.
BROOKLYN 17, NEW YORK, Dept. AH-3
Division of Scovill Manufacturing Company, Incorporated

Schrader PRODUCTS CONTROL THE AIR

Circle 37 on Reader Service Card

POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

Anker-Holth Manufacturing Company announces the appointment of four new representatives. **The Martin & Prestegaard Company,** 816 Metropolitan Life Building, is the exclusive representative in the Minneapolis territory. **William Blower,** 743 East Fourth Street, has been appointed as representative in the Milwaukee territory. **The New England Tool Company,** 2010 B. Commonwealth Avenue, Boston, will cover the New England States with the exception of Connecticut and the western half of Massachusetts. **Henry H. Van Cleef,** Box 247, Branford, Connecticut, will cover the state of Connecticut and the western half of Massachusetts.

Reese Machinery Company, 1012 Empire Building, Pittsburgh, Pa., have announced that **Glenn R. Kraus,** formerly with the Mesta Machine Co., and **Ernest C. Hawkins,** formerly with LeMaire Tool & Manufacturing Co., have now become associated with them to enlarge their force covering the Tri-State area.

Arthur S. Brown, president of the **Clapp Instrument Company,** Webster, Mass., has announced the appointment of **A. E. Campbell** as sales manager. Mr. Campbell has long been associated with the instrument industry as a sales executive.

The Pacquin Co., sales engineers for hydraulic accessories, have moved to 16134 St. Clair Ave., Cleveland, Ohio.

Chester H. Butterfield, vice president of Manning, Maxwell & Moore, Inc., has been named vice president in charge of the **Consolidated-Ashcroft-Hancock Division,** makers of valves, gauges and industrial instruments. Mr. Butterfield succeeds Hamilton Merrill, who was recently elected president of the company.

The next meeting of **SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment,** is scheduled to be held at the Hollywood Roosevelt Hotel in Los Angeles, California, on the dates of October 4, 5, 6, 1950.

Purchase by **The Centrifix Corporation** of a three story factory at 3608 Payne Avenue, Cleveland, Ohio, is announced by Randall T. Elliott, president. The recent purchase is described as an expansion and consolidation move made necessary by growing demands for high efficiency separation in the chemical and food processing, oil refining, power generation and industrial fields.

E. S. Russey, vice president and general manager of the **Warner Gear Division** of Borg-Warner Corp., has announced the appointment of **R. R. Rolph** as the division's Detroit sales representative.

Recent appointment of distributors stocking **Blackmer Pump Company's** entire product line and service parts is announced by B. L. Gordon, president. Included are

(Continued on page 56)

"O" RINGS SINCE 1941

Outstanding by nature—Parco Balanced Compounds + precision moulding make the outstanding hydraulic packing. For "O" ring packing, investigate "O" rings from Parco Balanced Compounds. All dash numbers of both 6227 and 6230 series for commercial application or Army-Navy installations to Specification ANP 79 are available from stock.

Catalog and engineering data on request. Write us today.

Copyright 1950

Parco

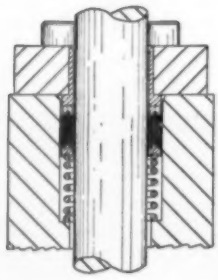
Plastic & Rubber Products Co.

2100 Hyde Park Blvd., Los Angeles 47, Calif.

919 N. Michigan Ave., Chicago, Ill.

Circle 38 on Reader Service Card

20 MILLION STROKES
from
0 to 2250 PSI
Prove
LINEAR "V" RING
Efficiency



The unretouched photograph shows a cutaway section of a set of five LINEAR "V" Ring packings . . . after 20,217,960 strokes in a vertical triplex pump, handling river water with solids of seven grains per gallon.

Previously the pump . . . with a rod of cold drawn Monel and operating at 144 strokes per minute . . . required an adjustable gland. But spring-loading the homogeneous type LINEAR "V" Rings permitted the use of a fixed gland, bolted metal-to-metal . . . providing automatic take-up for the packing. The result? A uniform and predictable seal life and elimination of dangerous over-tightening of the gland. When removed for examination, the LINEAR "V" Rings were sealing just as efficiently as when first installed!

In addition to these successful homogeneous "V" Rings, precision-moulded seals of fabric reinforced materials, fluoroethylene polymers, silastics and special synthetic rubbers are available to meet your specific requirements.

For lower costs and increased dependability, call LINEAR for specific information.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

Circle 39 on Reader Service Card

Circle 40 on Reader Service Card

SAVE UP TO 85% in WAR SURPLUS HYDRAULICS

SPECIAL BARGAIN #29 HYDRAULIC CYLINDER

Gives 20,000 lbs. thrust (push pull) using 1500 PSI line pressure as obtained from our hyd. pumps. Or will produce 40,000 lbs. thrust with 3,000 lbs. line pressure. CAN ALSO BE OPERATED ON LOW PRESSURE AIR SYSTEMS. 4" Bore, 1½" dia. piston shaft, 18" stroke, length 30⅞". Equipped with ball bearing loaded clevis type mounting and swivel type high pressure steel pipe bracket for easy use. Ideal for road farm and shop machinery, presses, etc. Cost Government $390.00 . . . . . NOW 22.50

HYDRAULIC CYLINDERS

NO. 3A – Bore 1½", Shaft ¾" Stroke 5", Length 10⅝" 5.75

NO. 9E – Bore 1-3/8", Shaft 1" Stroke 15-5/8", Length 15⅞" 8.50

NO. 35 – Bore 1½", Shaft 1" Stroke 26", Length 23½" 12.75

HYDRAULIC TRANSMISSION

Self contained, 2 H.P. constant torque at all speeds with variable volume reversible, piston pump (controlled by outside lever.) supplying piston hydraulic motor. Automatic pressure, Dash pot for smooth control. Power output R.P.M. – 0 to 1/3 input R.P.M. in both directions. Input R.P.M. 1800 continuous 4000 intermittent. Dash pot can be removed for greater R.P.M. Ideal for Lathes, Duplicator Setup on Mills, Conveyors, Small Cars, Drives, Gearing, etc. Includes 2 - 4" Splined Shafts for input and power take-off. Cost Government approx. $400.00 27.50

HAND PUMP

Provides an instantaneous source of tremendous power for almost any heavy work. Double action stroke. Delivers .30 cu.in. per cycle at 3000 PSI. Maximum pressure 5000 PSI. Has built-in reservoir with 2¼ qts. capacity. 3/8" pipe outlets and pressure release valve. Base is 7¾" diameter. Pump is 23 3/16" overall height. Weight 15.2 lbs. A $40.00 Value 15.95

Used-In good Condition 11.95

HYDRAULIC PUMPS

ANGLE PUMP

Positive displacement type, angle piston. Displaces .507 cu.in. per revolution. Has capacity of 6 gal. per minute at 3000 RPM at 1500 PSI continuous 1875 for 15 seconds. Operating speed of 3750 RPM, intermittent maximum 4500 RPM. Rotates to the right only. . . . . NEW 14.49

HP-3V-HAND PUMP

HP-3V-HAND PUMP – Operating pressure 2000 PSI. Capacity, 1.5 cu.in. per complete cycle. Has added feature of a diverter valve for selecting a suction & pressure port for two independent systems. . . . . ONLY 12.75

P-3 STRATO POWER PUMP With built-in variable flow control valve in head. Positive displacement piston type. Displaces .450 cu. in. per revolution. Two gal. per minute capacity at 1500 RPM at 1250 PSI. Pressure limit, 1250 PSI continuous. 1400 PSI for 15 seconds. Operates at 3750 RPM, intermittent max. 4500 RPM. Rotation either direction without adjustments. NEW 17.50

FOUR WAY VALVE

V-28 – Poppet Type. Off at neutral position. 3/8" AC Tube Ports – (9/16 - 20) thread. P.S.I. 1,500 . . . . . 4.75

V-17 – Poppet Type. Pressure balanced. Offat neutral position. Piston type with built-in relief valves for limit of cylinder strokes. ½" Standard pipe inlet & outlet ports. ½" AC tube to cylinder (¾" - 18) thread tapped ports. NEW 6.75

GEROTOR TYPE PUMP

Logan Gerotor type. For operating hyd. systems on tractors, trucks industrial machinery, etc. Delivers 8 GPM, at 1200 RPM, at 1000 PSI with 5 HP. Can also be used as Hydraulic Fluid Motor. Has 3/8" stnd. pipe ports, ½" splined shaft for pulley or direct attachment. 5½" dia. x 7" lg. Used but guaranteed condition. Now ONLY 17.50

We carry the World's Largest Supply of New Hydraulic Equipment featuring over 20,000 Cylinders in 61 Sizes & Types. Can also supply all accessories such as Pumps, Fittings, Valves, Tanks, Hose Fittings. Let us solve your Hydraulic problems. Write for inform.

PALLEY SUPPLY COMPANY 6321 SAN FERNANDO RD. DEPT. AP-9 GLENDALE 1, CALIFORNIA

WRITE TODAY for 1950 TOOL CATALOG 72 PAGES of BARGAINS in Machine tools (taps, drills, dies, reamers, etc.) Hydraulic Cylinders, Valves, Pumps, & Motors. Air Tools & Bearings.

CHIKSAN
HYDRAULIC SWIVEL JOINTS

This is but one of many different Types and Styles of CHIKSAN Hydraulic Swivel Joints for application on all hydraulic lines which must turn or swivel. Pressure capacities range from 1000 psi. to 3000 psi. Write for Bulletin A. Or tell us your requirements and CHIKSAN Engineers will gladly cooperate with you in developing Hydraulic Swivel Joints to meet your requirements.

CHIKSAN TRADE MARK REG.

CHIKSAN COMPANY

AND SUBSIDIARY COMPANIES

Chicago 3, Ill. BREA, CALIFORNIA Newark 2, N. J.

WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS

CHIKSAN EXPORT CO. BREA, CALIFORNIA NEWARK 2, N. J.

BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

Circle 41 on Reader Service Card

National Metal Show To Be In Chicago

THE 32ND NATIONAL METAL CONgress and Exposition will be held at International Amphitheatre in Chicago October 23-27. The American Society for Metals, the American Institute of Mining and Metallurgical Engineers, the American Welding Society and the Society for Non-Destructive Testing will each hold technical sessions concurrent with the Exposition.

A total of 350 exhibits will display the latest development in all branches of metallurgical and metal working fields. This Exposition attracts the "blue-chip" manufacturers, processors and suppliers whose exhibits will demonstrate the newest equipment, techniques and procedures.

In addition to technical sessions by the sponsoring societies, the American Society for Metals will conduct their annual educational lectures at twi-night sessions the first three days, a Business Forum in the Palmer House grand ballroom on Thursday and two Sales Clinics, one Sunday night October 22 and the other on Tuesday morning.

The fifth metallographic exhibit of ASM will occupy a large area of the International Amphitheatre. Exhibits under a dozen classifications will show micrographs in photograph halftones and as transparencies. Prizes in each class and a grand prize will be awarded.

Another feature that has proved very popular, will be the regularly scheduled showings of exhibitors' motion pictures. Films produced to depict procedures for lower unit costs and techniques for high production will be shown in theatres provided with professional facilities by the Metal Show management.

The ASM seminar on "Atom Movements" will be given in morning and afternoon sessions on Saturday and Sunday, October 21 and 22.

The Sauveur Achievement Award, established in 1934, will be awarded for 1950 to Clarence E. Sims, assistant director, Batalle Memorial Institute, for his pioneering studies and research into the origin and effects of inclusions in cast steels.

CHOOSING THE PROPER PACKINGS

(Continued from page 24)

dependent on the finish of the surface.

Chrome plated and polished rams and cylinders will pay dividends in long life, low maintenance and continued production.

Clearance

While the subject of small clearances was emphasized under "O" rings, it is also important that it be considered carefully for all types of packings of any material. Excessive clearances will result in short packing life, particularly at high pressures because the packings will extrude and be ruined.

The foregoing facts on packing design and application are important if one is to expect long efficient packing life. The packing is the heart of any piece of hydraulic equipment and if it is not designed and applied correctly it will not work properly and neither will the equipment in which it is installed. Therefore, if the designer will incorporate in his design of the equipment the proper packing for the work to be accomplished, taking into consideration temperature, type of fluid or gas used as an operating medium, and will design according to known practices, using packing standards for size and shape, his problems will be minimized. The user will find greater efficiency, greater production and a reduction in his manufacturing costs.

No costly mechanisms needed!

Lindberg Double Acting Air Cylinders are proving their adaptability and worth in a wide variety of industrial uses. These simple, dependable, efficient and versatile cylinders are effecting considerable savings throughout industry by the reduction or complete elimination of costly mechanisms involving cams, gear drives and complicated set-ups.

Don't forget—with slight modifications, any size or model of Lindberg Air Cylinder may be used for low pressure hydraulic applications.

WRITE FOR NEW BULLETIN 731—this 16 page catalog just off the press gives details of all standard Lindberg Air Cylinder models and sizes with complete tables on bores, pressures, weights, mountings and conversion to low pressure hydraulics.

Remember—BULLETIN 731 for COMPLETE DETAILS ON AIR CYLINDERS

LINDBERG

AIR & HYDRAULIC CYLINDERS

Lindberg Engineering Company
2441 West Hubbard Street Chicago 12, Illinois

Specify Lindberg
when you need HYDRAULIC CYLINDERS
OIL HYDRAULIC PUMPING UNITS
MILL TYPE CYLINDERS • CENTRIFUGAL
BLOWERS • AIR VALVES

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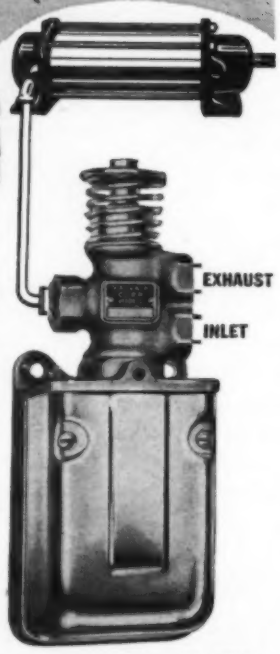
Circle 43 on Reader Service Card

This VALVAIR SOLENOID OPERATED AIR CONTROL VALVE is Sensationally Dependable!



. . . and its dependability is due to many quality features. *Examples*: the "O-U" packer, no metal seats, heavy solenoid and standard pipe area through valve, permitting unrestricted air flow and preventing pressure loss. Yet Valvairs cost no more.

For use with air, water or oil pressures up to 175 p. s. i.; temperatures up to 120° F. 2-way; piped exhaust — 3-way, 4-way. Also in knob, lever, cam, clevis, foot, treadle, cylinder, diaphragm types.

Sizes: ¼", ⅜", ½", ¾", 1".

★ ★ ★

Ask for Bulletin "A-H".

VALVAIR CORPORATION • 454 Morgan Avenue, Akron 11, Ohio
AFFILIATE: SINCLAIR-COLLINS VALVE CO.

Rely Upon Valvair 2-WAY 3-WAY 4-WAY

(Continued from page 50)

$$F \text{ (Driver Gear)} = \frac{W\,DP}{2\,P_d}\,[(N+4)K-4]$$

$$F \text{ (Driven Gear)} = \frac{W\,DP}{2\,P_d}\,[(N+4)K]$$

The nomenclature used in the above formulas follows:

W = Gear Face Width
DP = Differential Pressure
N = Number of Teeth
P_d = Diametrical Pitch
β = Suction angle

$$K = 1 + \frac{\sin\beta}{\pi - \beta}$$

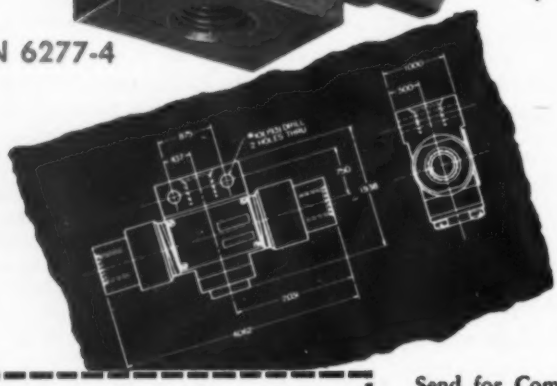
It should be noted from the above formulas that the bearings on the driven shaft are more heavily loaded than those on the driver. This is due to the fact that on the driven gear the components add together, whereas on the driver gear several of the components tend to cancel each other.

While the selection of bearings for gear pumps is fairly simple, there are many different considerations entering into the design. The final choice will depend upon evaluation of bearing life required, boundary dimension assembly, and cost, as well as bearing loads.

The formulas have been developed by Engineering Department, Bearings Division, The Torrington Company, Torrington, Conn.

* *Chief Engineer and Assistant Chief Engineer respectively.*

AN 6277-4



3,000 psi AN Approved

KENYON SHUTTLE VALVE

THE KENYON SHUTTLE VALVE WAS SPECIFICALLY DESIGNED TO . . .

- *Eliminate* failure due to "O" ring swelling . . .
- *Rapidly* shuttle against a *blocked line* . . .
- Produce *zero* leakage during shuttling cycle . . .
- Permit side loads on the shuttle to *transmit* directly to the body, leaving the pistons free to *align* themselves . . .

Years of experience in hydraulics has again resulted in Kenyon producing a unit which exceeds specifications . . .

KENYON INSTRUMENT CO., INC.
HUNTINGTON STATION, L. I., N. Y.

KENYON INSTRUMENT CO., INC.
1539 New York Ave.,
Huntington Station, L. I., N. Y.

GENTLEMEN:

Please send me the folder containing complete engineering data on the AN approved 3,000 psi Shuttle Valve.

Name_____ Title_____
Company_____
Address_____
City_____ State_____

Send for Complete Engineering Data Folder . . .

OTHER DEVICES MANUFACTURED BY KENYON . . .

HYDRAULIC . . . Check, Relief, Restrictor, Multiple Selector, Thermal Expansion Valves, Balanced Relief Valves, Line Filters. PNEUMATIC . . . Pressure Regulators, Solenoid Actuated Valves. FUEL AND OIL VENT SYSTEM . . . Vacuum Check, Vent Check, Check-Relief Valves. CONTROLS . . . Flexible Shafts, Gear Boxes, Tab Actuators, Torque Tube Drives. PRESSURE GAGES . . . Accumulator Charging, Differential Pressure and Hydraulic. ULTRA-SENSITIVE TEMPERATURE DETECTORS for all temperature ranges.

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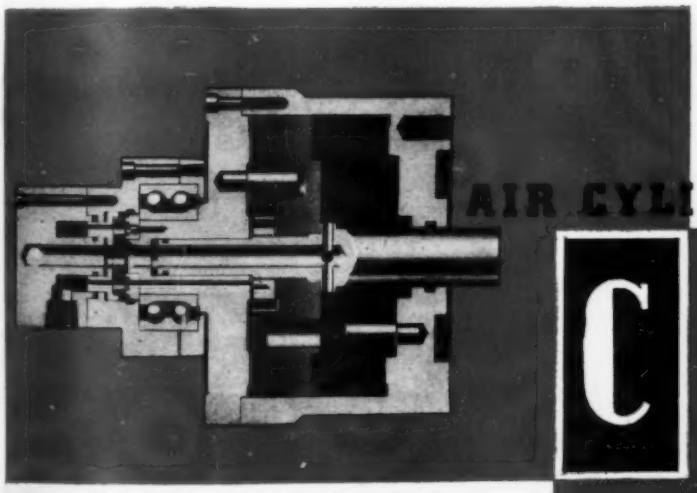
COST-CUTTING IS NOT AN ENJOYABLE SPECTATOR SPORT!

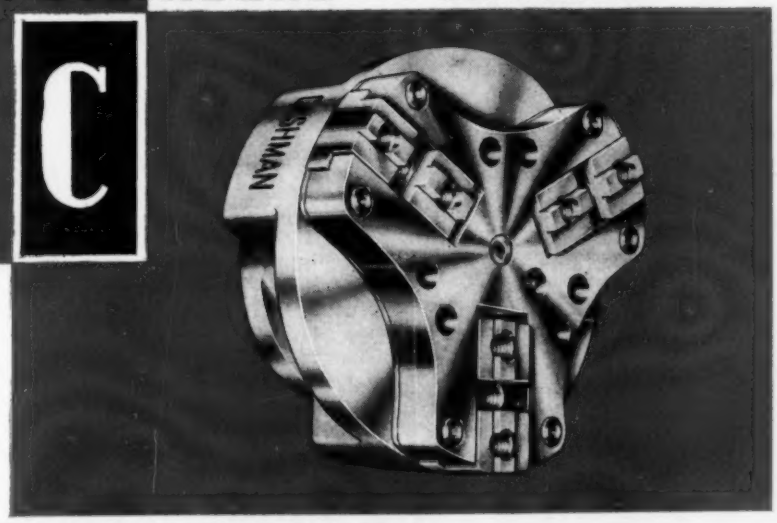
Of course, it's a great deal more interesting . . . and more profitable . . . to *lead* the way in getting your manufacturing costs down, than to have your competitor force you into it.

That is why we invite you to get the facts about ultra-modern Cushman Power Chucking methods and equipment NOW . . . without delay. Our engineering department is extremely busy showing a growing list of metal working shops how recent developments . . . like super-speed machining with Aluminum Body Power Chucks and Air Cylinders . . . can effect cost reductions that mean something in the final price structure. Write us at once for current bulletins or outline your tooling and production needs and we'll be glad to make recommendations.



CUSHMAN
High speed
ALUMINUM BODY
AIR CYLINDERS *and* **CHUCKS**

Raise your Speed limits
and lower your costs



CUSHMAN

THE CUSHMAN CHUCK CO.
Hartford 2, Connecticut

CUSHMAN ALSO MANUFACTURES A COMPLETE SERIES OF WRENCH OPERATED CHUCKS . . . WRITE FOR CATALOG 64
PCS50

(Continued from page 51)

Blott-Robb Company, Transmission Machinery Company, and Amco Corporation, all in Chicago. H. O. Link Co. in Baltimore, Tri-State Equipment Co. in Kansas City, and Avels Sales and Engineering Co. in Indianapolis.

Richard Dudgeon, Inc., one hundred year old manufacturing firm in New York City, has moved from 24-26 Columbia Street, where it has been located for ninety years, to new quarters at 789 Bergen Street, Brooklyn, New York.

Chicago Belting Company announces the formation of a wholly owned subsidiary to be known as the **Allis Seal Corporation. Frederick E. Barth** has been appointed executive vice president and **Rexton S. Rainey** becomes vice president in charge of engineering.

Mert M. York has been named manager of **Allis-Chalmers** Boston district office, according to an announcement by C. W. Schweers, manager of the New England region.

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VICKERS
HYDRAULIC (OIL) CYLINDERS

MANY ADVANTAGES

Modern in design and appearance, Vickers Hydraulic Cylinders are built for longer, more satisfactory service in oil hydraulic systems. Polished rods, honed cylinders and self-adjusting packing minimize friction. Universal mounting positions, "O" Ring gaskets, piston rod wiper, multiple piping positions are other features. Adjustable integral cushions available in all types. There is a Vickers Cylinder for your job.

MANY STYLES AND SIZES

Write for BULLETIN 49-55

VICKERS Incorporated
Division of The Sperry Corporation
1400 Oakman Blvd. • Detroit 32, Mich.

1474

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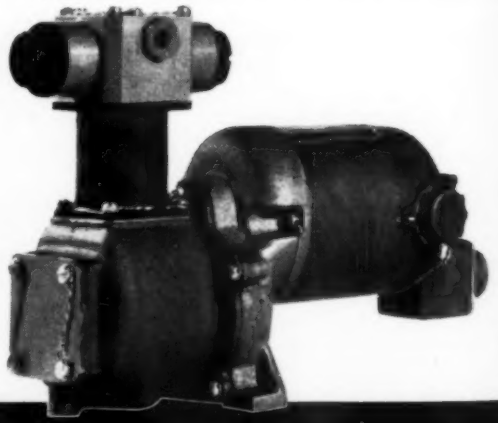

Model 100-322C
Motor Driven Air Compressor

- Dry air type pressurizing compressor Built in relief valve
- Capacity — 1200 cu. in. per minute free air
- Weight — 3 lbs. 7 oz.
- Totally enclosed motor 27 V. DC - 1.2 amps.
- Lubricated for life
- For use up to 50,000 ft. altitude

Specialists In Hydraulic and Pneumatic Development

GREAT LAKES MANUFACTURING CORP.

1046 E. 134th STREET • CLEVELAND 10, OHIO

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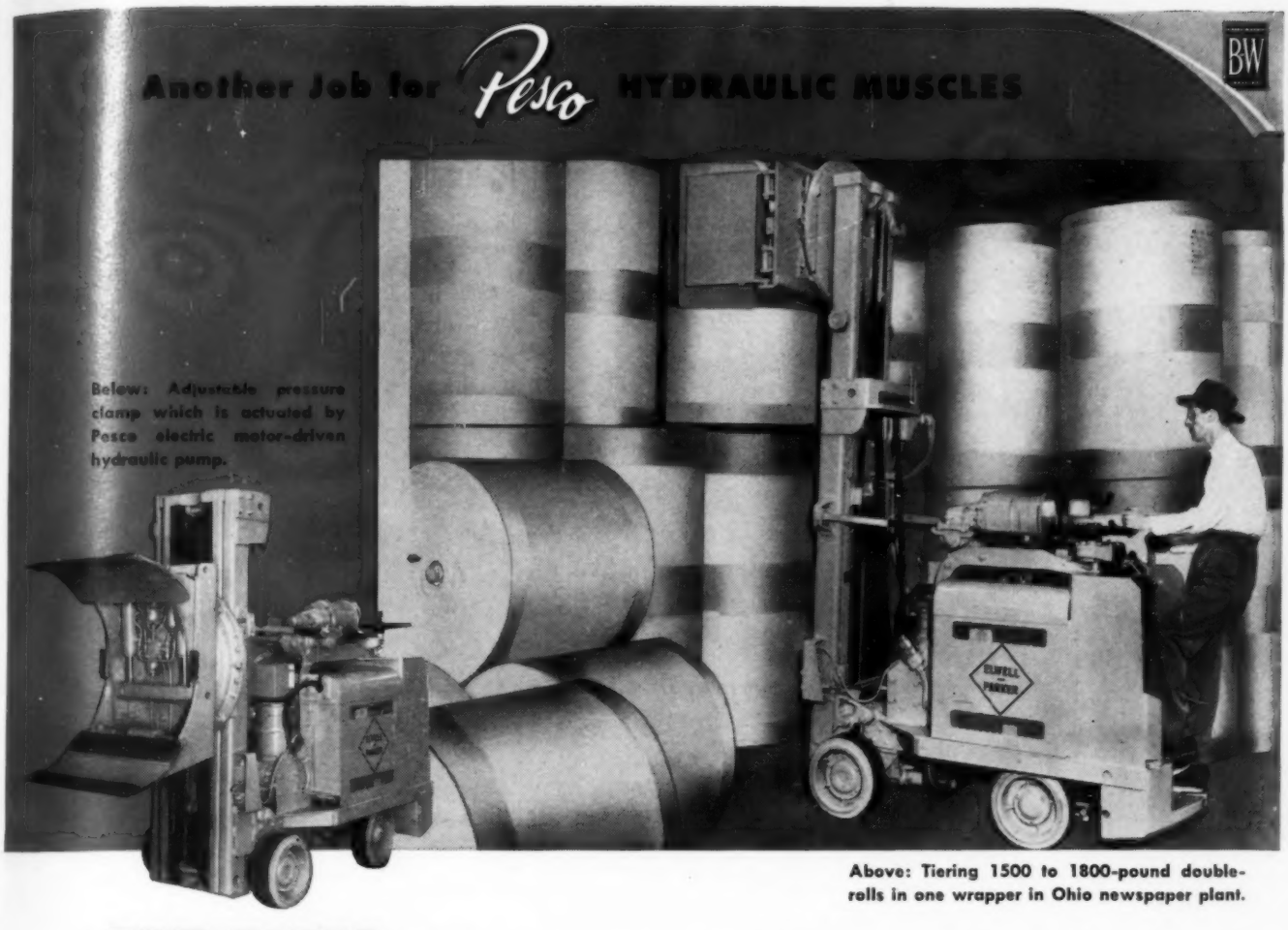
Another Job for Pesco HYDRAULIC MUSCLES



Below: Adjustable pressure clamp which is actuated by Pesco electric motor-driven hydraulic pump.

Above: Tiering 1500 to 1800-pound double-rolls in one wrapper in Ohio newspaper plant.

HEAVY rolls of paper handled easier, faster

. . . with new Elwell-Parker, Pesco-equipped Clamp Truck

This Pesco hydraulic motor has displacement of 1.92 cu. in. and develops 4.4 hp. at 1000 p.s.i. at 1200 r.p.m.

Capacity of this Pesco electric motor-driven pump is 1.6 g.p.m. at 1650 p.s.i. at 27 volts d-c.

Savings up to 75 per cent in time—savings in storage height and the ability to "nest" paper rolls weighing up to 3500 pounds are some of the advantages of this new Clamp Truck.

Two Pesco units help to make these savings possible. A Pesco electric motor-driven pump moves the clamp that grasps the paper roll and holds it firmly, but without damage to the paper, while stacking. And a Pesco hydraulic motor provides the power that rotates the clamp mechanism so that the rolls may be stacked on end or laid on their sides.

The preciseness, ease and speed with which Pesco hydraulic muscles handle heavy, awkward loads is only one of many important reasons why more and more industrial equipment manufacturers are turning to Pesco for answers to their hydraulic power problems.

For the complete story of how the sales power of Pesco Pressurized Power can help you, write today.

engineering Pesco production

PRODUCTS DIVISION

BORG-WARNER CORPORATION

24700 NORTH MILES ROAD BEDFORD, OHIO

What is so right about this picture?

Is it that Dad's finally retired . . . the old alarm clock gagged for good?

Is it because now Mom won't have to watch him leave for the office any more, looking just a little bit tired?

Or is it because now Dad and Mom will be starting an especially happy time of life *together?*

We think it's all these things—all the things that are only made possible by financial security.

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